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Electrical World

McGraw-Hill Company, Inc. New York, December 27, 1919 Fifteen Cents a Copy

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Published December 31 With Current News

Electrical World

The consolidation of ELECTRICAL WORLD, ELECTRICAL ENGINEER *and* AMERICAN ELECTRICIAN

Volume 74 New York, Saturday, December 27, 1919 *Number* 22

Homeward Bound

WITH the closing of the final forms of this issue the ELECTRICAL WORLD leaves Buffalo to re-establish in New York City the editorial, business and mechanical staffs in its home quarters. From temporary offices in Buffalo nine issues of the paper, including the present number, have been published since Nov. 4. This impromptu transfer of publishing routine was found necessary after our New York printing plant had been closed for more than four weeks by the striking printers in that city. It marked a break in the regularity of issuing weekly the ELECTRICAL WORLD in New York for nearly half a century—a situation which has now been overcome by the plan of combining two or more issues under one cover, in order to span the period of suspended publication, and by the return of our printshop force, making it possible to re-establish with the first issue of January the former date of publication as of Saturday of each week. During the period of irregular publication none of the material originally planned for regular issues has been eliminated, for this has been incorporated in the three special combination numbers and the single issues that preceded and followed them. Because of the plan followed the volume for the second half of 1919 has been completed in twenty-two numbers instead of twenty-six. The total number of pages, however, is only sixty-four behind that of the corresponding volume last year.

While some time-honored precedents in page size, type dress and the like have been broken, we have not broken the one aim so long and successfully maintained by the ELECTRICAL WORLD of furnishing through its engineering and news pages a service of the highest possible order, regardless of the cost of production. It is gratifying to learn, through many letters received, that our efforts in this emergency under most trying circumstances have been appreciated. To those readers who have written us and to all our other subscribers, who have borne with us the difficulties of the past three months, we wish a happy and prosperous new year.

More than 75 per cent of the graduates of the Massachusetts Institute of Technology in war service became officers. Could there be a more striking argument than this on behalf of technical education? Officers for the industrial army are needed equally to meet and overcome the problems of peace, and through education and research our institutions of technical training must be backed to the limit by the people at large in the interest of preserving and advancing the civilization of this complex but glorious century.

Customer Tolerance

ONE of the reasons why many buyers cannot get goods more promptly is because they insist on special designs rather than accept standard apparatus. If it were really true that all buyers needed other than standard products to fit their conditions, this situation could be passed without discussion; but the truth is that many would be better off with standard than with special products. When the materials of manufacture and labor are both plentiful and price is no object such a condition may be tolerated, but with the present shortage of goods and the high cost of labor it is reasonable to expect that each buyer will consider his necessities carefully before he decides that he must have non-standard apparatus.

Utility securities should be in the investment and not in the speculative class. State regulation which protects the investor by granting the public service corporations an adequate rate of return makes these securities legitimate investments and also permits the utilities to get necessary funds at a lower rate of interest. This also benefits the public because cheaper money is reflected in lower rates for service.

Destruction and Construction

A SERIES of plates running through several issues of our French contemporary the *Revue Generale de l'Electricite* shows war's destruction at its worst. The plates give view after view of electrical power houses in the devastated regions of France as they were before the German invasion and as they are now. The battered exteriors are bad enough, but the interior views of empty foundations and twisted junk where a few years ago mighty machines pulsated and wide-spreading networks centered are worse. Before these ruins, says our contemporary, one could uncover as before a tomb. Small wonder if forgiveness shall remain foreign to the thoughts of Frenchmen of those regions as long as these desecrated shrines of industry bear mute witness to the debauch of wanton destruction and cold-blooded robbery in which the invaders indulged.

Speaking of destruction, however, it has its uses. With material as with immaterial things, the outgrown, the useless, the shabby should go. Our cities would soon be incomparably more attractive if this principle could be applied scientifically to their buildings. There is something wrong with urban development when, on the one hand, stately old structures whose timbers are as sound as when they were put in place, or others around which historic memories throng, disappear before the march of

improvement, while in nearby streets mean and malodorous buildings defy the hand of time. If it were possible to throw into a modern city an army of engineers, under the leadership of a L'Enfant or a Haussmann, not to build up a few grand streets and squares, but to develop waste spaces, demolish the haunts of squalor and transform the tenement and factory districts if not into beauty at least into salubrity and neatness, abolishing filth, smoke and odors and flooding the remotest alleys with electric light, peace would achieve one of those victories which Milton declared to be no less renowned than those of war.

The responsibility for the actual operation of industrial plants rests very largely upon the electrical superintendent whatever his title may be. He in turn must delegate responsibility and work to others, so that his success is a measure of his ability to train his electrical employees, and more especially his foremen, for their work. The foremen are like sergeants in the army. They are the men upon whose co-operation and skillful efforts the electrical superintendent must depend to carry out his plans successfully.

The Central Station and Merchandising

PRACTICE as regards the extent to which local electric light companies enter into merchandising varies in different parts of the country. In the Far West, where special contractor-dealer activity has brought the standard of retail dealers to such a point that they can adequately handle the sale of appliances of all types, the electric power companies do only a fraction of their former merchandising. This is especially true in California, where, through the efforts of the California electrical co-operative campaign, contractor-dealers throughout the state have bettered their business methods, put on solicitors to push the sale of washing machines and the larger appliances, and have generally increased the sale of energy-consuming devices through the rendering of better service to the public. Elswhere the electric lighting companies still handle large quantities of electrical appliances.

Redistribution of this business can be brought about in only one way—through the bettering of the business methods of the retail dealer until trade naturally flows to his door. Until the small retailer is prepared to push the sale of appliances a desertion on the part of the electric central station would mean the entire loss of the business, not its transference to another channel. Trade by and large cannot be forced. It drifts naturally to the door which offers it the best service. The leaders of the contractor-dealer movement should recognize this and bend their efforts to the improvement of the small store. The part which the electric power company should be called upon to play is not to give up merchandising unless it can do so advantageously, but to foster all movements which make for wider distribution and sale of appliances. The electric lighting company must, however, conduct its merchandising on a business basis, with profit to itself and without unjust or unlawful competition with electric supply dealers or others in the community. It is against public policy to permit a monopolistic business to expand in other directions to the hurt of other businesses in a community, unless it can be shown that the business is handled at a fair profit and is for the ultimate good of the consumer.

Simplicity in Plant Design

THE genuinely simple plant is just about as common and popular as the genuinely simple life. Certainly there are some stations which, from the complications of the distribution served, are necessarily intricate. Others become so from what the psychiatrists recognize as initiative obsessions. Still others merely from a laudable but expensive desire to give the bondholders a run for their money. It is therefore a pleasure to take notice in our columns this week of an Indiana steam plant doing service in the coal-mining region which not only could be but is of unusual simplicity.

To being with, the station itself is simply planned. The coal, which comes from the company's own mine, is lifted to the top of the station, whether from cars or storage, by a cantilever crane, dumped through a hatchway in the roof, and then passed to the bunkers either directly or through a portable crusher. There are big boiler units with underfeed stokers provided with both induced and forced draft. The steam and electric plant is arranged on the very sensible plan of allowing each bank of boilers and its turbogenerator to act as a unit. There is a capacious equalizing steam line between the groups, but it is not intended for transfer purposes except in an emergency.

On the electrical side there are no low-tension buses and no intricate switchboard to serve them, but the interconnections are wholly on the high-tension side, and the 2300-volt leads from the generators are taken straight to out-door transformer banks, also operated as units with their respective generating systems. Protection to the generators is furnished by a low-tension oil switch for each, installed where it should be, inside the station near its generator. The two banks of transformers raise the pressure to 33,000 volts, at which it is taken to a switching structure with two sets of 33,000-volt buses connected to the lines by air-break switches. These switches are operated by rods from inside the station. By this very simple design it was possible to build the station even in war time at a moderate cost, and in spite of a low load factor the station runs at most creditable economy. Incidentally it should be noted that the entire station crew of three shifts consists of only sixteen men for 35,000 kva. capacity. Four 33,000-volt lines leave the station and supply a population of more than 100,000 in five counties over about 200 miles (321 km.) of transmission with twenty-two substations. The substations and switching stations, like the generating plant itself, are of extremely simple construction. The pole lines are of cedar, treated, spaced about 145 feet (44 m.) and carrying the circuits on pin-type insulators rated at 44,000 volts, thus giving a good factor of safety. Obviously not every transmission plant can be reduced to so near its lowest terms as this one, but it is an example which for its very simplicity is well worth studying and which might well be followed to advantage elsewhere.

Motor application surveys are always fashionable in times of high-cost and possibly scarce fuel. The periodical testing and skilled appraisal of motor fitness have yet to become accepted as a matter of course by numerous concerns too willing to drift along in the belief that so long as a motor "carries on" all is serene as to efficiency. Must it take as long to convince such plants that motor testing pays as it did to educate the mechanical world to the value of steam engine indicating?

Industrial-Scholastic Co-operation

AN INTERESTING departure from the scholastic routine is proposed by the Massachusetts Institute of Technology, which offers its services to various industries in a consulting capacity on the basis of an annual retainer, according to a plan of activity announced a short while ago. It is felt that the potential resources of the institute have hardly begun to be tapped and that a basis of co-operation can be worked out which will be mutually helpful to the school and to the industrial world. In return for the fee, the institute agrees to permit the client corporation to make use of the library, files and plant; to consult with members of the staff and faculty on problems pertaining immediately to the client's business, and to place at the disposal of the client in each case a record of the qualifications, experience and special knowledge of alumni which is likely to be helpful.

This proposal to capitalize the patent and latent resources of a great engineering educational plant for the benefit of industry is of considerable significance. It appears, properly safeguarded, to offer a means of enlarging the usefulness of technical schools generally, particularly along the lines of research. If it works at Cambridge, it will doubtless work elsewhere, and at first blush it looks like a sensible and forward-looking program.

Introspective thinking on electric service rates for farmers has failed to accomplish anything for the central stations or the public in the way of a solution of the farm-lighting problem. It is time that a broad view of the situation were taken in the economic interest of the country. Here is a big job for a commercial committee of the National Electric Light Association.

Induction-Generator Plants

THE prevailing type of alternator all the world over is the polyphase synchronous alternator. It has the advantages of reliability and flexibility to demand. If the power driving it falls off, the machine may continue to run in synchronism on light load, or even as a motor. On the other hand, a synchronous alternator ordinarily requires to be synchronized before connecting it to the system. This operation requires some experience and skill. If the alternator should at any time fall out of step, the synchronizing must be repeated in order to restore its operation.

An induction generator may be described as an induction motor reversed in its functions by being driven above synchronous speed. It has the advantage that it does not need to be synchronized when brought into operation. It may be allowed to come up to speed as a motor connected to the circuit, and then, by being driven above synchronous speed, it will pick up its load as a generator. Its disadvantage is that it absorbs a relatively large amount of reactive power from the system in its excitation, and so tends to lower the power factor.

L. J. Moore describes this week the main features of two semi-automatic induction-generator plants operated by the San Joaquin Light & Power Corporation in California. These plants have been built for utilizing two small hydraulic heads and are so arranged that they may be thrown into or out of service with the minimum of attendance cost.

Developments in Southern California

THE great network of the Southern California Edison Company has been growing at a rate which compels constant activity to keep up with the demand. Just now the situation is more than usually strenuous, and it has been necessary to add nearly 40,000 kw. to the capacity of the northern transmission stations and to add a big storage reservoir to the hydraulic capacity. Concurrently come changes in the substations and distributing networks, of which J. A. Lighthipe had an interesting story to tell in out last issue. The constitution of the system as it stands is somewhat complex. The great fundamental transmission lines are at 150,000 volts. These feed the 60,000-volt lines, chiefly of earlier construction, which center at the Eagle Rock substation, just out of Los Angeles, and serve what were at one time the longer runs of the network and a few new links of the system.

The general distributing service to the numerous public and private substations is at the very moderate pressure of 15,000 volts, again a heritage from less venturous days; and this in turn delivers energy for the house-to-house primaries. There are thus very generally five transformations between the far-off generators and the consumer's meter. This sounds truly formidable, but it must be remembered that this system spans the whole history of electric power transmission, and the real marvel is that it has been so far simplified and standardized. The great engineering problems which stand out in such a situation are regulation and continuity of service, and Mr. Lighthipe's paper bears very directly upon their solution. The general scheme of operation is to supply each load center from more than one transmission line, so as to continue through the network the duplication of lines found in the far-reaching main supply lines. To realize the full benefit of this a beginning is being made in the equipment of the chief distributing lines with unidirectional relays, which operate in such a way as to cut out a short-circuited line automatically, leaving its mate intact.

As to regulation, the burden of holding the voltage at the Eagle Rock substation is thrown upon synchronous condensers with automatic control. There are three of these, two of 15,000 kva. and another of 30,000 kva., equipped with protective relays to cut out any machine that may be grounded or short-circuited. The same method is now being further extended, for in the new substation at Torrance, the largest distributing center of the entire system, a 6000-kva. synchronous condenser is being installed to steady voltage and power factor in the district thence served. At this point all the high-voltage equipment is out of doors, while that for the 15,000-volt low-tension (how casually one mentions it to-day!) is housed under a roof in a real building.

There is again duplication in the 15,000-volt buses, and we note that the disconnecting switches guarding the oil switches have been dropped, very sensibly, since the duplicate bus gives all the needed reserve. It is a hopeful sign of a healthy tendency toward simpler switchboards. There must some day be an end to setting a watchman over the guard, a sleuth over the watchman, a spy over the sleuth, and rather often over the spy a yellow dog who bolts at a critical moment and upsets the whole scheme of salvation.

Semi-Automatic Induction-Generator Plants

Features of Two Stations Operated by the San Joaquin Light & Power Corporation and Principal Problems That Had to Be Solved

BY L. J. MOORE
Electrical Engineer San Joaquin Light & Power Corporation

WHILE induction generators have been considered extensively of late for automatic generating stations, relatively few have been installed up to the present; therefore the features of some existing semi-automatic stations with accounts of operating experiences may be of interest to all engineers. The two plants with which this article deals were placed in operation early in 1919 by the San Joaquin Light & Power Corporation and were briefly described in the ELECTRICAL WORLD for Nov. 2, 1918. At that time no wiring diagrams were shown because the final details had not been worked out. Now, however, the plants have been in operation several months, and the results have been so gratifying that there is no question that a considerable output in kilowatt-hours has been made available at small expense.

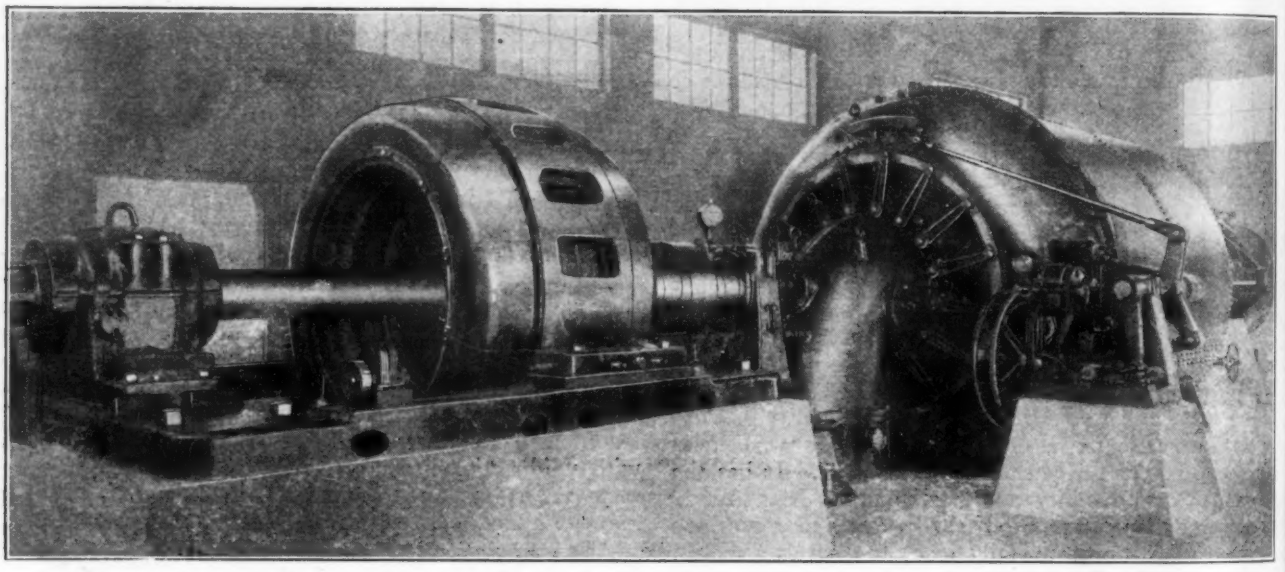


FIG. 1—ONE OF THE INDUCTION GENERATORS OPERATED BY THE SAN JOAQUIN CORPORATION

The plants are known as power house 1-A and Crane Valley power house respectively. The former has the greater amount of control apparatus, consisting chiefly of float control to permit full usage of water, apparatus for automatically disconnecting the machines in case of line short circuit or de-energizing of lines, and arrangements to prevent serious pipe vibration.

DESCRIPTION OF POWER HOUSE 1-A

Power house 1-A, the smaller of the two, is built on the 150-cu.-ft. (4.24-cu. m.) per-second flow line to the company's power house No. 1, just before the point where the water empties into the forebay reservoir for that plant. The contour of the ground at that point is such that the lower end of the flow line is at an elevation of about 45 ft. (13.5 m.) above the water in the forebay. Originally the water was carried in steel pipe down the hill to the reservoir and allowed to run into it without any use being made of the fall, the pipe not being under head but being used simply as a flow line. For the new plant a 60-ft. (18-m.) wood-stave pressure pipe was laid by the side of the steel pipe and the water now passes through it and is carried into the automatic power house, which discharges directly into the reservoir. The wood-stave pipe is carried on concrete saddles about 8 ft. (2.4 m.) apart and follows the contour of the ground, which is such as to make it an inverted siphon. In the case of the old pipe trestles were built across the low part of the contour. A drain valve was installed at the lowest point on the wood-stave pipe and an air valve at the point where the pipe enters the power house. No standpipe was provided at the intake because the water to the pipe is controlled by a Taintor gate in the flume some 20 ft. above the end of the pipe, so that there is no chance of a vacuum being created in the pipe by a closure of the gate. An automatic bypass was provided around the pressure pipe by the construction of a weir over which the water rises and spills when the plant shuts down. The weir spills into the old pipe line, which was left in position. This bypass is necessary at this plant because the No. 1 power house is a station of large output and nothing can be allowed to interfere with its water supply.

The accompanying wiring diagram shows the electrical connections. The generator is a 42-kva., 6600-volt, 245-r.p.m. induction machine, driven by a 600-hp., 39-ft. (11.7-m.) head, end-inlet, double-discharge Francis-type turbine. Power is transmitted at the generating voltage

a distance of about 4400 ft. (1320 m.) to power house No. 1, where it is stepped down to 2300 volts and connected to the main busbars of this plant.

FLOAT CONTROL OF WATERWHEEL

The gates of the turbine are operated by a 1-hp., 220-volt, three-phase induction motor, the direction of rotation of which can be regulated by the closing of the proper contactor on the control panel. No waterwheel governor has been provided. The control of the turbine gates can be given to a pull-button switch for hand operation by closing the triple-pole, double-throw switch on the control panel to the proper position. The other throw on this switch gives the gate control to a float for automatic operation. The float is at the intake to the pipe line and is set to close a pair of contacts when the water begins to spill over the weir, or to close another set when the water is drawn down to a distance of 9 in. (22.5 cm.) below the crest of the weir. In the first case the turbine gates are open until the water starts to fall and the float switch contacts open, and in the other case the gates are closed until the water starts to rise again. The motor is geared down so that the gates work quite slowly, and in that way the travel is not far before the float switch opens owing to change of level of the water at the intake. In fact, the regulation is so close that about forty-five minutes is taken for the water to be drawn down from the spilling point to the lower limit of the float's travel, and about the same time is taken for the reverse operation. With this float arrangement the maximum possible output is obtained from the water flowing in the ditch, and any change in the quantity flowing is automatically followed by a change in load on the plant. The two signal lamps on the board indicate high and low water respectively, and when the float is intermediate between the contacts neither lamp is burning.

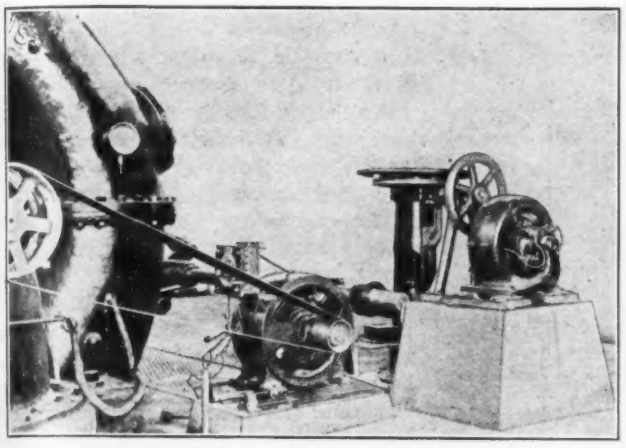


FIG. 2—GENERATOR DRIVEN BY WATERWHEEL SHAFT OPERATES TURBINE GATES

In "putting the plant on the line" the attendant brings the unit to the proper speed by using the pull-button control on the gates. He then closes the oil switch and, still with the button control, brings his load up until neither signal lamp is burning. He then throws the double-throw switch to the float-control position and the job is done.

Relay equipment and float control were installed at power house 1-A for the reason that the ditch or conduit in which this plant is located is the main flow line for power house No. 1 and the quantity of water in it is frequently changed. By means of the float the plant is made to automatically pick up or throw off load, depending upon the amount of water flowing in the ditch. In this way it is unnecessary for the attendant to be called to readjust the gate opening on the turbine for changes of water in the ditch. With a given gate opening of course the decrease in the flow of the ditch would result in a vacuum being drawn on the pipe line, or an increase in the amount of water in the ditch would result in water passing over the spillway and the failure to obtain all of the kilowatt-hours in the water.

PREVENTING OVERSPEED OF INDUCTION GENERATORS

In case the power line is deënergized from power house No. 1 the low-voltage release on the oil circuit breaker disconnects the plant from the line, thus preventing load being thrown back onto the semi-automatic plant with the induction machine still connected and running at a high rate of speed. To provide for overspeed, either from the line opening at power house No. 1 or for any other reason, a centrifugally operated switch is provided on the shaft to close a set of contacts that in turn operate the gate motor in a direction to shut down the unit. An overload relay with circuit-opening hand-reset contacts is used as an interlock, so that when the motor is closing down for overspeed the float cannot operate it to open up, as would be the case immediately the water began to rise at the intake. Three reverse-power relays have been installed and connected to open the generator oil switch, by means of a no-voltage release, in case of failure of the water supply causing a reversal of power.

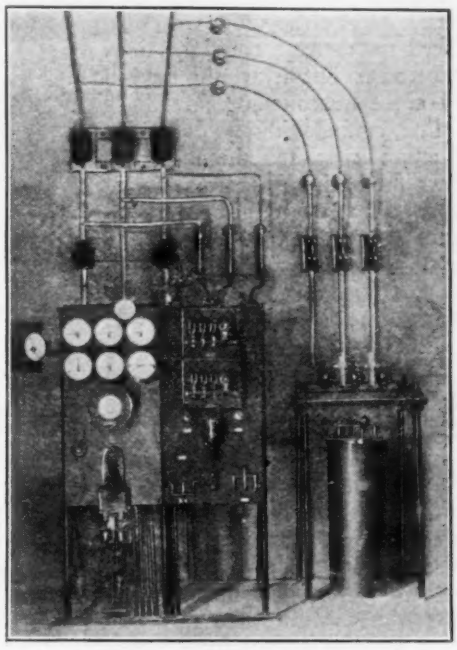


FIG. 3—CONTROL PANEL FOR INDUCTION-GENERATOR SET AT POWER HOUSE 1-A

To engineers who have thought of induction generators being connected to the lines with little if any automatic control it may be necessary to explain the reason for in-

stalling the foregoing apparatus at all. While an induction generator cannot run away if it is connected with synchronous machines whose speed is normal, it may happen that a short circuit occurs or line voltage is otherwise reduced to such an extent that the induction generator receives no excitation, in which case it will run away. In this particular district these conditions could easily occur. Since the units were designed for full runaway speed no damage could be done from this cause, but it would be difficult to get synchronous plants back on the line again without damaging the induction machines because full voltage would be impressed on the induction generators while they were running much above normal speed. In the opinion of the writer, this would be as severe punishment as throwing them on the line at standstill.

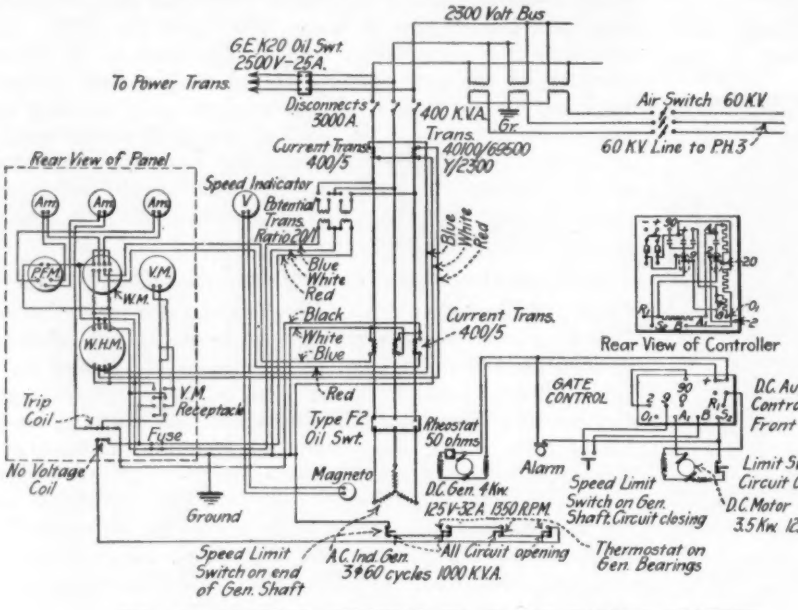


FIG. 4—CONTROL CIRCUITS IN CRANE VALLEY STATION

It was found that the gates of the turbine leaked so much that if the water in the ditch was cut down to below 5 cu. ft. or 6 cu. ft. (0.14 cu. m. or 0.16 cu. m.) per second the pressure on the pipe line could not be maintained. As a result the water would come to the same level in the two legs of the inverted siphon, but the generator would be kept up to speed by power from the line. In this way the turbine acted as a centrifugal pump and attempted to pump all the water out of the pipe line, setting up vibrations which were dangerous to the wood-stave pipe. By the installation of reverse-power relays this condition will be taken care of and the unit be immediately disconnected from the line on any reversal of power. It has also been found that it is practically necessary to close the butterfly valve just ahead of the turbine when the unit is disconnected. Otherwise the pipe line is drained until the water is level in the two legs of the inverted siphon, and as a result when the full head of water comes in the ditch in the morning it traps air in the pipe when filling it. This has also caused considerable vibration and has resulted in opening up leaks.

No provision has been made for automatic starting because a man is kept at the reservoir at all times and he can start up the plant when necessary without interfering in any way with his other duties. It was, therefore, felt that automatic starting devices with the control wires which would be necessary between the automatic power house and power house No. 1 would simply entail a needless expense. No alarm circuit has been provided because three circuits of the company's private telephone lines go to the attendant's cottage and his attention can be called by power house No. 1 if at any time the indicating meter on the line installed at that plant shows that power house 1-A has tripped off the line. The gate control motor is operated by power taken directly from the line. No auxiliary source of power has been provided because the short distance from power house No. 1 makes the chances of interruption few. On account of the low speed of the unit no protection has so far been installed against hot bearings.

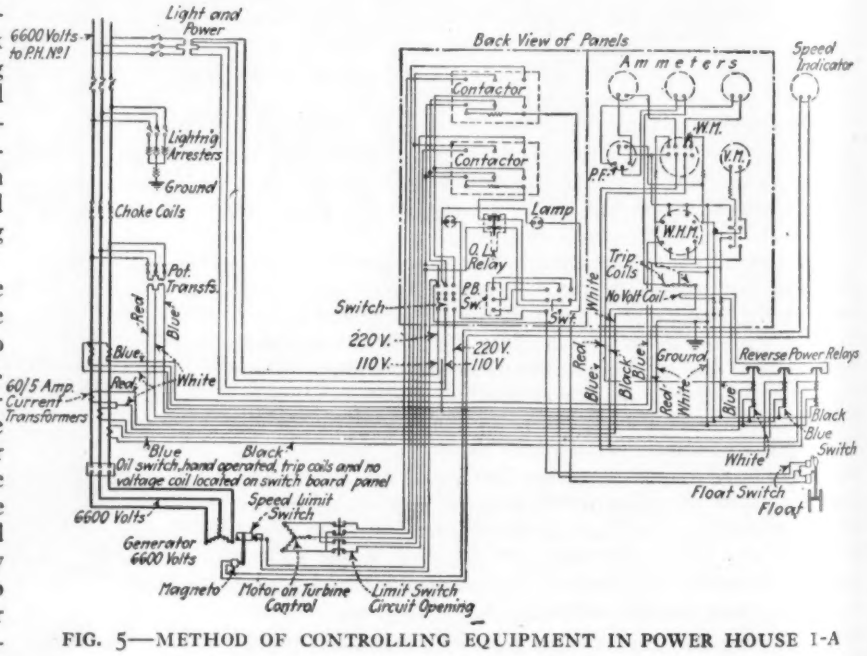


FIG. 5—METHOD OF CONTROLLING EQUIPMENT IN POWER HOUSE 1-A

The float switch was made up in the company's own shops, because no standard make of float switch seemed to fill the requirements. The usual type starts the motor when the water level is low and stops it when the tank, or other device controlled, is full. In the control of this plant it was desired to have the switch start the motor

when either limit of travel was reached and to stop it again as soon as the level of the water began to move toward the other limit. The float as constructed has a water displacement of about 20 lb. (9 kg.), thus giving very positive action. The float is installed between the screens and the intake to the pipe so that it will not be affected by clogging of the screens.

CRANE VALLEY POWER HOUSE

The Crane Valley power house contains a 1000-kva., 2300-volt, 458-r.p.m. induction generator coupled to a 1310-hp., 100-ft. (30-m.) head, single-discharge, overhung Francis-type turbine. This plant takes its water directly from the Crane Valley storage reservoir. The head in the reservoir varies from a maximum of about 117 ft. (35 m.) down to a minimum of about 60 ft. (18 m.), but the average is about 100 ft. A 48-in. (120-cm.) pipe line is incased with concrete to the lower end of the tunnel and carries the water to the turbine, which discharges directly into the conduit for No. 3 power house. Provision is made to bypass the water around the plant, but the operation is not automatic in this case, the attendant having to close the butterfly valve on the turbine and open bypass valves from the pipe.

In this plant there is no wood-stave pipe to consider and no chance for the water to get past the automatic power house without going through the waterwheel, so no automatic equipment has been installed except an overspeed device for shutting down the machine in that contingency. This apparatus was considered necessary because the induction plant might be left on the transmission line with only one or two small synchronous plants and with very little if any load during switching or trouble. Unless the water were turned off, the waterwheels would generate considerably more power than necessary for running the synchronous plants as motors at normal speed, provided the gates were wide open. As a result the whole district would be subjected to overspeed. It is therefore considered a good plan to have the induction plant taken off the line and the wheel closed down, thus making it possible for the synchronous plants to get back in step with the remainder of the system and the induction generator plant to be placed on the line later by the attendant.

From the wiring diagram it will be seen that the turbine gates are operated by a small direct-current motor driven by a direct-current generator which is belted to the shaft. No operation of the gates is provided for except to close down the unit when it goes off the line in trouble or when the power on the line fails. The centrifugally operated switch on the generator shaft responds to about 35 per cent overspeed, opening the no-voltage coil on the generator oil switch and also operating the automatic controller on the gate motor. The motor continues to run until the limit switch on the gates opens at the closed position.

The object of the speed-limit switch opening the generator oil switch is to take care of a case in which the plant might be left on the line with one of the small synchronous plants in that district but without any load being connected. This might possibly occur during switching or trouble. In such a case the output of the induction plant is sufficient to cause overspeed on the synchronous plant.

Thermo-relays are installed on the bearings and connected to open a no-voltage release on the oil switch, thus disconnecting the unit from the line in case of a hot bearing. Here again the overspeed feature shuts down the unit and rings the alarm for the attendant. The momentum of the unit is always sufficient to drive the direct-current generator long enough for complete operation of the gates. In fact, the gates never close tightly enough to stop the machine entirely. Load changes on this plant are made on an average possibly twice a day by the caretaker of the dam and reservoir.

These plants were built for the purpose of developing two small heads, and it was necessary to keep the cost of the installation to the minimum if the development was to be economical. Induction generators were therefore selected on account of their simplicity of operation and the low cost of the installation, no exciters or other auxiliaries being necessary. Such machines are easily designed for overspeed and do not create high voltage when they are dropped off the line and attain high overspeed. In such a case the excitation which comes from the system immediately fails. Short circuits on the line have the same effect. No synchronizing is required, and therefore skilled operators are not needed.

PERFORMANCES OF THE TWO INDUCTION GENERATORS

The accompanying power-factor curves show the actual conditions under load. It will be noted that the higher-

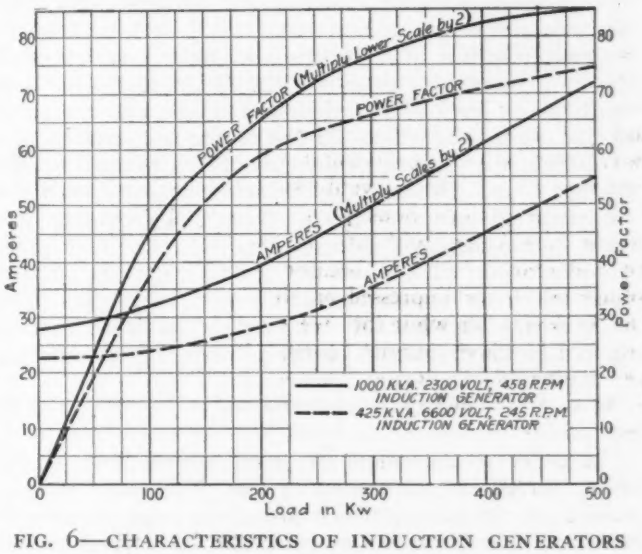


FIG. 6—CHARACTERISTICS OF INDUCTION GENERATORS USED BY SAN JOAQUIN COMPANY

speed machine is much better from the power-factor standpoint, requiring less lagging kva. from the line for excitation. As yet full load has not been carried on the higher-speed plant on account of low water in the reservoir, but the curve indicates very favorable conditions. Even with the lower power factor at power house 1-A no serious effect is experienced, because the size of the unit is such that a large amount of kva. is not required for excitation.

The total capacity of such machines that can safely be installed on any system is a matter of study in connection with the individual system. If the resultant system power factor is anywhere near unity, a reasonable amount, say 10 per cent, of the system capacity in induction generators would not be seriously detrimental.

Transmission-Line Reconstruction Problems

Methods and Economic Principles Involved in Analyzing the Cost of Improvements, Rebuilding, Replacement and Other Similar Problems on Transmission Lines—Utilization of Old Materials

BY P. O. REYNEAU * AND H. P. SEELYE

In a previous article on transmission-line economy, entitled "Selection of Economical Transmission Route," which was published in the ELECTRICAL WORLD July 26, 1919, the subject of the economy effected by the use of a shorter route for a transmission line was discussed. This article dealt only with the case where the line is a new one, serving new territory or giving additional capacity in old territory by a new route. Another problem is taken up in what follows.

A GREAT number of the problems in transmission-line work involve the consideration of reconstruction; that is, the improvement or enlargement of a system already in operation. For example, it may be desired to determine the advisability of shortening a line already in operation by rebuilding part of it over a new route. Or it may be necessary to meet an unforeseen increase in the load carried by rebuilding an old line, increasing the size of the wire, adding an additional line on the same poles, or changing the voltage. For convenience the term "reconstructed line" will be used to designate the line after such improvement. In any such case it is necessary to consider the fact that the old line has more or less of its serviceable life left, and the value of this must be added to the cost of the new construction in determining the total investment represented by the finished line. This total is the amount upon which the reconstructed line must pay a return and should be justified by the increased capacity obtained. Or, in a problem of economy such as shortening a line, it is the amount upon which the annual cost of the new installation must be figured. This annual cost must be less than that of the old line if there is to be any advantage in the change.

TOTAL INVESTMENT REPRESENTED IN RECONSTRUCTED LINE

In order to determine the total annual cost of the reconstructed line or section of line, it is easier to consider first the factors which affect the total investment involved, either to increase or decrease it. It will at first be assumed that the new line is to be entirely of new construction and the old line is to be salvaged. Later the use of old material in the new line will be discussed. It is evident that, for the purpose of this analysis, the amount of investment represented by the old line as it stands must be computed on the principle of the cost to reproduce it in its present condition at present prices. It is to be replaced by new construction at present prices, and the comparison of annual costs of old and new must be on the same basis. This amount may be obtained by figuring the detailed cost of such a line, including material and labor, at present prices and subtracting from this a percentage of the whole equal to the fraction of the total assumed life of the line which has already elapsed. The value of the elapsed life is assumed to have been paid for in the return from the operation of the line up to the present time. If, now, a new line is built to replace the old and the old line is removed, there is added to the total investment the cost of all the new material used and the labor involved in the change. From the total investment is subtracted the salvage value of the material recovered. The investment represented by the old line as it stands is thus increased by:

1. The cost of the material used in the reconstructed line.
2. The cost of the labor necessary in the building of the reconstructed line.
3. The cost of the labor necessary in dismantling and removing to the warehouse the material in the old line.

The investment is decreased by the present value of the material in the old line (*i.e.*, its cost if new, less a percentage of depreciation for age). Hence the net increase in investment equals cost of material in reconstructed line plus cost of labor in reconstructed line plus cost of labor removing old line minus present value of material in old line.

As was explained above, the investment represented by the old line equals present value of material in old line plus present value of labor in old line. It is evident that the last item in "net increase in investment" cancels the first item in "investment represented by the old line"; hence this quantity "present value of material in old line" does not enter into the "total investment represented."

Therefore the total investment represented by the new line equals present value of labor in old line plus cost of material in reconstructed line plus cost of labor in reconstructed line plus cost of labor removing old line.

In other words, a new line built to replace an old one which has not outlived its usefulness represents an investment of the present value of the labor of erecting the old line and the cost of labor in removing the old line in addition to the total cost of material and labor in erecting the new line.

ANNUAL COST OF RECONSTRUCTED LINE

Investment Charges.—In order to obtain the yearly cost chargeable to the reconstructed line, which is the quantity which must be used in considering its economy, it is necessary to spread this total investment over a period of life estimated for the new construction. The percentage to be charged annually must include interest, taxes, insurance and depreciation. Ordinarily at least two different percentages will be used in actual computation. One will apply to labor investment which has no salvage value and to materials such as poles, cross-arms, pins, etc., which have a comparatively short life, and whose scrap value at the end of the useful life is probably about equal to the cost of labor necessary for salvaging. Another figure will be used on such material as bare copper wire, which has practically no physical depreciation. Its value at the end of the life of the line is as great as at present,

* Distribution engineer the Detroit Edison Company.

provided that prices do not decrease, and the only expense incurred will be the labor cost of salvaging. The market value of copper has varied so widely during the past few years that a great element of uncertainty is introduced into this item. For this discussion, however, it will be assumed that the price of copper will remain constant. For the present both these percentages will be represented by the letter g.

g = per cent interest, taxes, insurance and depreciation chargeable annually against the construction.

The expression "$g \times$ (any quantity)" merely indicates that it is the annual charge against that quantity which is being considered.

Operating Charges.—Another element of annual cost is the operating expense. The chief item under this head will be that of energy loss. If the reconstructed line is of higher voltage or of larger-sized wire than the old, or if the length is shortened, the energy loss may be materially reduced. This will tend to reduce the annual cost and is an important item when relative economy is to be considered. Here, again, considerable uncertainty is introduced on account of the variation in load factor and load at present and in the future. The value of these items must be selected for the particular problem by careful study of the local conditions, since here, as in any engineering problem, the solution must be based on certain definite assumed values for all variable quantities. The success or failure of the solution will depend upon the good judgment used in such selection. The operating expense also includes the cost of superintending, repairing, patrolling, etc., which will in most cases probably not be materially different on the reconstructed line from what it was on the old line. In case the difference is marked this point must be taken into consideration in the final decision.

General Equation for Annual Cost

A general equation may now be formulated for the annual cost of the reconstructed line by combining these factors:

Annual cost of reconstructed line =

$$g \begin{Bmatrix} \text{Present value of labor in old line} \\ +\text{cost of material in reconstructed line} \\ +\text{cost of labor in reconstructed line} \\ +\text{cost of labor removing old line} \end{Bmatrix}$$
$$+\text{cost of superintendence, repairs, patrolling, etc.}$$
$$+\text{cost of energy loss on reconstructed line}$$

Similarly, the annual cost on the old line=

$$g \begin{Bmatrix} \text{Value of material in old line} \\ +\text{value of labor in old line} \end{Bmatrix}$$
$$+\text{cost of superintendence, repairs, patrolling, etc.}$$
$$+\text{cost of energy loss on old line}$$

By proper selection and application of the percentage g and computation of the various costs involved, in accordance with local conditions, these equations may be applied to any problems of reconstruction such as determining the relative economy of replacing a present line with one of higher voltage or larger wire or of shortening a line by rebuilding part of it.

Utilization of Old Materials in Reconstructed Line

In the above discussion it was assumed that all the old material would be salvaged. It very often occurs, however, in such cases as an increase in voltage that the new line may to advantage follow the old route for part of the distance at least, using the old poles and in some cases the old cross-arms, insulators, etc. The general equation still holds good for this condition if its derivation is kept in mind and the various items adjusted to fit the conditions. The "cost of material in reconstructed line" must include the "present value" of the old material used, since, it will be remembered, this originally entered the equation as a credit (to be salvaged) and was canceled out. The "cost of labor in reconstructed line" must be reduced owing to the fact that the old material used is already in place, but it must also include any labor cost necessary to adapt the old material to the new conditions. The "cost of labor removing old line" will, of course, be reduced by the amount that would be required for the material not removed. The value of g must also be selected to take into account the fact that the present life of the old material will not be so great as the new, and hence the labor necessary in adapting it will have a greater yearly depreciation. With these conditions clearly in mind, however, it is evident that the general equation may be safely applied to any such problem of reconstruction, even when part of the old construction is to be utilized. This would include also the case where a second line was to be added on the same poles.

Conclusions

In any problems involving reconstruction of a line still serviceable, the investment cost and annual charges pertaining to the old line must be included in the costs chargeable to the new line. These costs will be increased or decreased by the various extra expenditures or savings belonging to the new line. It is proposed in the next installment of this article to show how the general method can be applied to specific cases and how in some cases "short cuts" may be introduced to simplify the problem greatly.

THE government took over the possession and management of certain *quasi* public concerns, and, with the assistance of a large part of the previously formed organizations, realized some success in operation, but as a total result the experiment was a failure. Every day that passes furnishes evidence to justify this assertion. The properties and businesses taken over have been or will be returned to the owners for the real reason, if not admitted, that the undertakings were too big and complicated for new and inexperienced chiefs to manage. What the results of this experiment will be as to the future value of the properties no one can, with accuracy, predict. It cannot be entirely satisfactory to the owners or, for some years at least, to the general public. . . . There was clearly demonstrated during the war the value and practical benefit of private management as compared with public management. If it be said that government conduct of business has sometimes been successful, the answer is that the same business in the hands of private, responsible individuals, with capital and success at stake, would have resulted more favorably.—*E. H. Gary.*

Supplying Electricity to Coal Mines

Extreme Simplicity of Plant Design, Standardization of Lines and Substations and Diversity of Load Are Among Outstanding Features of Interesting Indiana Installation

THE 35,000-kva. steam plant serving the principal coal-mining regions of Indiana, which has recently been completed by the Indiana Power & Water Company of Edwardsport, Ind., is interesting from an engineering viewpoint because in its design and construction the governing consideration was to make it as simple and as inexpensive as possible without going to extremes which would result in poor service. The transmission lines and substations also deserve attention because they represent a step toward the development of standard types of installations for this service. Even the load itself is interesting because from it the central-station man can learn something about the characteristics of this type of service, which seems destined to grow in use and in popularity.

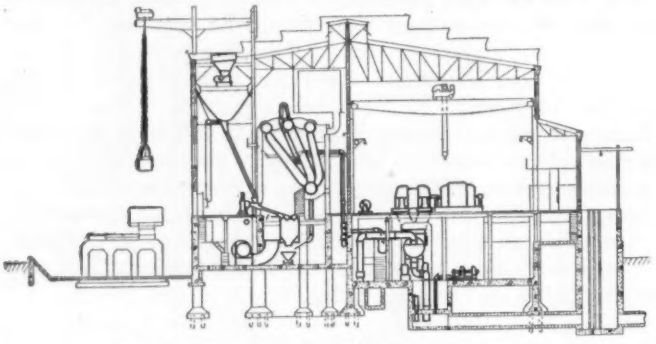


FIG. 1—CROSS-SECTION OF EDWARDSPORT PLANT OF INDIANA POWER & WATER COMPANY HOUSING ONE 5000-KW. AND ONE 2500-KW. TURBO-GENERATOR

In designing the plant the engineers simply said: "The plant must have boilers, turbines and transformers to convert coal into electricity for delivery to the high-tension lines. We will install and connect up this equipment with as few 'frills' as possible, including only the essentials." The result was a partly indoor, partly outdoor station without the usual complications which are sometimes called refinements. In discussing the design, now that the plant is in operation, the engineers do not regard it as one that would be applicable to all stations. They do feel, however, that for the service this plant must give the design is entirely satisfactory.

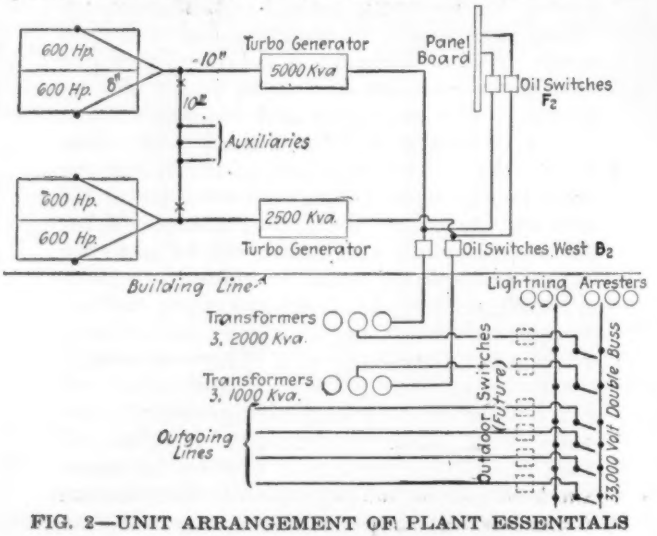


FIG. 2—UNIT ARRANGEMENT OF PLANT ESSENTIALS

How Cost of Building Station Was Reduced

On reference to the one-line drawing of the station essentials and to the cross-section through the plant, it will be seen that coal, which comes from the company's own mine, may be taken either from the cars or from a concrete storage pit and lifted to the top of the station by means of a cantilever crane. The coal is then dumped through a hatchway in the roof, reaching the bunkers either directly or after passing through a crusher that can run the full length of the bunkers. The coal is burned on underfeed stokers under four 600-hp. Stirling boilers in furnaces designed for large volume and for accessibility. The center line of the mud drum of each boiler is 8 ft. (2.4 m.) above the floor. The furnace contains no arch. Its bridge wall, which is 8 ft. (2.4 m.) high, contains an observation door through which the fireman can reach the dump-plate area with a slice bar if necessary. Forced draft for the boilers is supplied by interchangeable fans placed under the firing aisle. Induced draft is obtained by a stack 220 ft. (67 m.) high and 15 ft. (4.5 m.) inside diameter. Ashes are dumped directly into industrial cars that run beneath the ash pits. The ash-car tracks are below high-water mark of the White River at this point, so provision

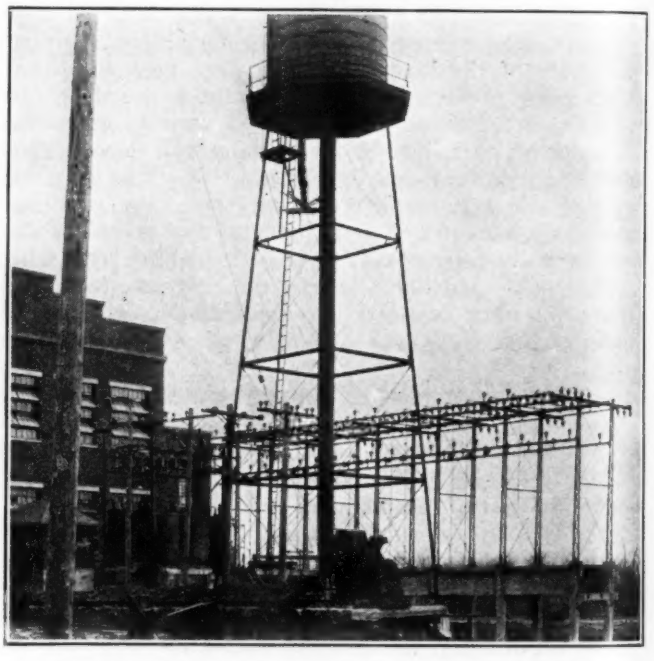


FIG. 3—THE OUTDOOR AIR-BREAK SWITCHING STRUCTURE

has been made for hoisting the ash cars by means of a steam hydraulic lift. This type of lift was selected because it could be operated at any time when steam was in the boilers, even with electrical equipment idle, and because it has been found trustworthy. All boilers are equipped with soot blowers.

The steam piping is remarkably simple and is laid out with the idea that primarily each bank of boilers and each

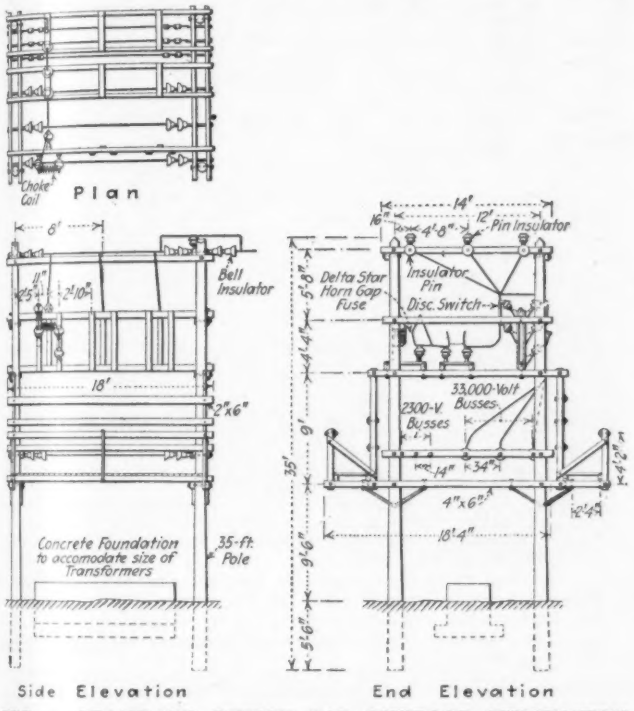


FIG. 4—STANDARD DESIGN FOR OUTDOOR SUBSTATION

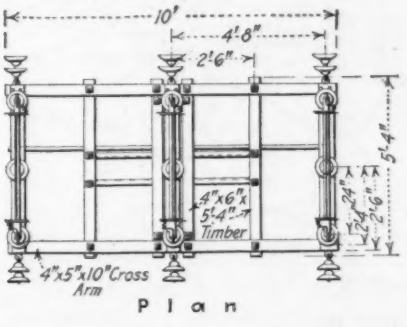
turbine shall act as a unit. An 8-in. (20-cm.) line leading from each boiler forms a "Y" with a 10-in. (25-cm.) line to the turbine. There is a 10-in. (25-cm.) line between units, but this is intended more as an equalizer line than as a transfer line, and it is not contemplated that any larger line will be installed when the station is extended. All steam-driven auxiliaries are fed from this line.

Real innovations in design were made in the electrical end of the plant. The customary low-tension buses and their accessory apparatus have been entirely omitted. The 2300-volt generator leads are taken through a cable tunnel directly out of doors to the two transformer banks, which are also operated as units with their respective generators and banks of boilers. The only equipment installed in the cable leads between the generators and their respective transformer banks are oil switches set just inside the station. Taps are taken from the generator leads from both sides of these switches and are carried to the station switchboard, which supplies electricity for the plant and for a small amount of local distribution.

It should be noted at this point that all of the larger motor-driven auxiliaries operate at 2300 volts. These include an exciter, pumps and fans. The smaller motor-driven accessories, which operate at 220 volts, are all supplied from three 30-kva. transformers. Station lighting is taken from a separate single-phase, 20-kva., 2300/110-volt transformer. Further details regarding the rating, types, number and makes of all plant apparatus are tabulated on page 1156.

From the two banks of transformers, which operate at 2300/33,000 volts, circuits are taken to a switching structure built of expanded steel poles set on a concrete base. On this structure there are two sets of 33,000-volt buses. The transformer leads coming to this structure are arranged so that either fed line can be thrown to either bus by means of air-break switches. All of the four outgoing lines are arranged the same way. The air-break switches are operated manually from the inside of the station by means of semaphore rod and handle equipment such as is used in railroad work. This gives a flexible switching arrangement that has proved very satisfactory. Should occasion arise for a great deal of high-tension switching, it will be possible to install oil switches for 33,000-volt operation; but it is not contemplated, however, that this will be done in the near future.

Obviously the great advantage of the simple construction employed throughout this station is that of low cost. Ground was broken for the construction of the plant in May 1917 and the first unit was placed in operation in June 1918. Practically all of the work was done, therefore, during the so-called "high-cost" era when materials not only were costly but were hard to get. However, in spite of this situation, it was possible to build the plant



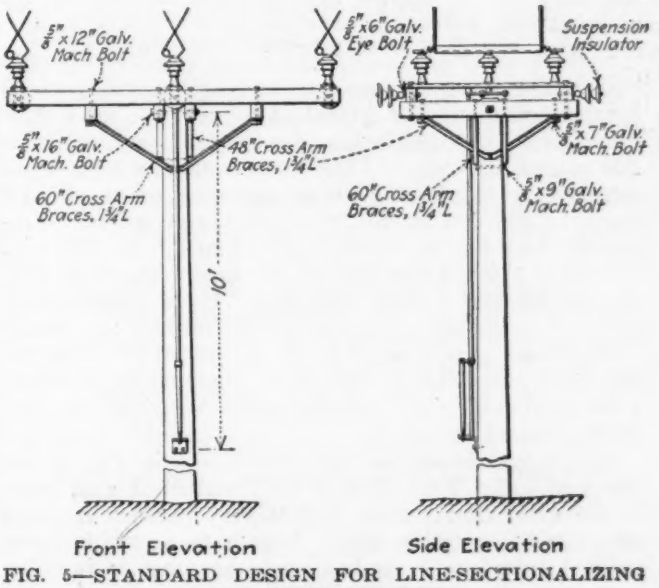


FIG. 5—STANDARD DESIGN FOR LINE-SECTIONALIZING SWITCHING STATION

as it stands at a cost per kilowatt which compares most favorably with pre-war prices. Besides being inexpensive as to first cost, the station also shows good coal economy, there being days even now, with the station only partly loaded, when records of 3 lb. (1.4 kg.) of 10,500 B.t.u. coal per kilowatt-hour are made. Owing also to its simple

design the station is economical in its use of labor, as there are only sixteen men composing its entire crew of three shifts.

SERVING THE LOAD

The destinations of the four 33,000-volt lines which leave the station are well shown on the map of the territory served. The company supplies a total population of about 100,000 in five counties, Sullivan, Knox, Daviess, Greene and Pike, in which eight old-type steam plants were shut down; twenty mines with a potential capacity of 60,000 tons a day, and sells energy in bulk to the Central Illinois Public Service Company and to the Wabash Valley Electric Company, reaching territory with an aggregate population of 50,000 additional. To reach these communities and these mines, the company operates about 200 miles (322 km.) of 33,000-volt transmission lines and twenty-two substations with an aggregate rating of 9900 kva. In addition to this, the demands of the two companies which buy at wholesale will run around 600 kva. for the Wabash Valley Electric Company and 1500 kva. for the Central Illinois company. These loads are all served through substations, switching stations and standardized lines. In addition to the equipment listed on this page, each substation is fitted with a switchboard carrying a low-tension oil circuit breaker and a Westinghouse type R. A. demand meter.

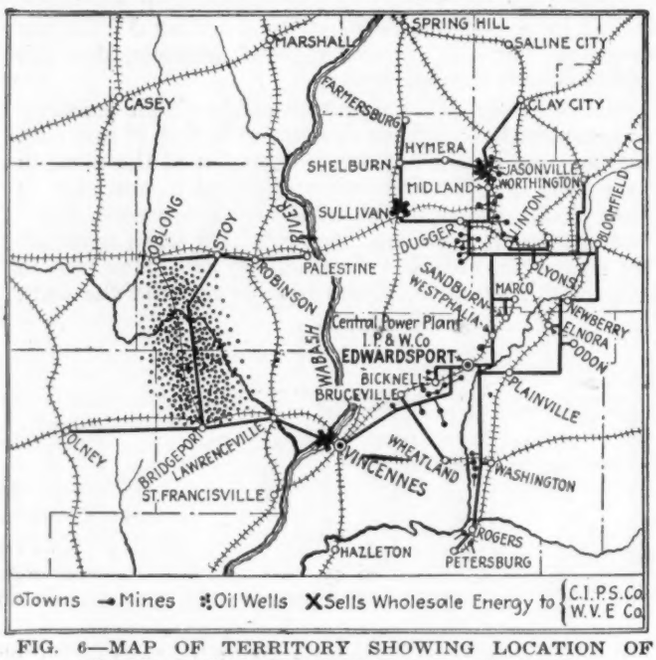


FIG. 6—MAP OF TERRITORY SHOWING LOCATION OF TOWNS, MINES, OIL WELLS AND INTERCONNECTION WITH OTHER COMPANIES

Switching stations like the one shown in Fig. 5 are also standard. Two of these are installed at each point in the main transmission lines where a branch is taken off. One is installed on the branch to permit it to be isolated from the main line, and the other is installed in the main line just beyond the tap made for the branch. Opening these two switches will permit all of the circuit beyond the branching point to be cut off the system. This facilitates locating possible trouble and the making of line repairs with dispatch.

In the lines flat-top construction is employed, using 35-ft. (11-m.) Idaho cedar poles with 7-in. (18-cm.) tops, the butt being treated to a twenty-minute bath of hot carbolineum and a one-minute bath of the same material cold. The wire is generally No. 4 medium-drawn copper supported on 44,000-volt insulators on steel pins in wooden arms. The ordinary span is 145 ft. (44 m.) long.

At the present time the loads which these lines transmit to the plant produce a plant peak of about 3500 kw. daily. Sometimes this occurs around 10 a. m., and sometimes the peak will come around 5:45 p. m., this being dependent on the operating conditions of the various mines. If a good many mines are in operation on any particular day, the chances are that they will all get well under way by 10 a. m. and produce a peak at that time. If a smaller number are running, the combined industrial and lighting load may cause a peak in the afternoon. At the present

DETAILED PLANT DATA ON EDWARDSPORT STATION

Boiler Room:

- Four 600-hp. Stirling boilers, 225-lb. steam pressure, 150 deg. superheat.
- Four Westinghouse underfeed stokers, seven retorts per boiler.
- Two Sturtevant forced-draft fans capable of giving 300 per cent boiler rating, driven by 76-hp. steam turbines.
  Vulcan soot blowers.
  Instruments for each boiler, grouped on separate boards, include a CO_2 recorder, a General Electric flow meter, a flue-gas temperature recorder, a three-in-one draft gage, and in addition there is a damper regulator for each pair of boilers and an indicating wattmeter for the boiler room.
- Two Warren-Webster 2000-hp. feed-water heaters.
- One Cameron 250-gal.-per-minute, three-stage, boiler-feed pump driven by a General Electric 3000-r.p.m. steam turbine.
- One Gardner plunger pump 250 gal. per minute.

Coal-Handling Equipment:

- One Bedford Foundry & Machine Company cantilever crane with 1½-yd. bucket, good for 35 tons of coal an hour, which can be doubled by changing gears and bucket.
- One Jeffrey single-roll crusher.
- One 250-ton Brown Hoisting Company suspension-type bunker.
  1000-ton outdoor coal storage, concreted.
- Two 1-yd. Koppel ash cars.

Turbine Room:

- One 5000-kva., three-phase, 60-cycle, 2300-volt, 3600-r.p.m. Westinghouse turbo-generator, guaranteed to give a steam rate of 14 lb. per kw.-hr. at 3000-kva. load and 13.2 lb. at full load.
- One Westinghouse 8000 sq. ft. surface condenser with a 110-hp. circulating pump for the 5000-kva. unit.
- One 2500-kva., three-phase, 60-cycle, 2300-volt Allis-Chalmers turbo-generator guaranteed to give a steam rate of 14.4 lb. per kilowatt-hour at full load.
- One C. H. Wheeler Manufacturing Company jet condenser with two radio-jet air pumps for the 2500-kva. unit.
- Two 100-kw. exciters, one driven by a steam turbine and one driven by a motor.
- One 35-ton Bedford Foundry & Machine Company crane.
- Three 30-kva. transformers for auxiliary power.
- One 20-kva. transformer for station lighting.
- One set of electrolytic lightning arresters on each high-tension bus.
  Nine-panel switchboard, including one panel for tapping the leads of the two generators, two exciter panels, one local feeder panel, two house-service panels, one tap panel, one blank panel and one Tirrill regulator panel.
  Recording instruments include wattmeter and voltmeter on total plant load.

Outdoor Equipment:

- Three 2000-kva. single-phase, oil-insulated, water-cooled Westinghouse transformers, 2300/33,000 volts.
- Three 1000-kva. single-phase, oil-insulated, self-cooled Westinghouse transformers, 2300/33,000 volts.
- Ten Delta-Star 200-amp. P. M. air-break switches.
- Ten sets operating mechanism made by General Railway Signal Company.

Building:

(Measures 80 ft. by 120 ft.) Located on North Branch of White River and on Pennsylvania Railroad.
Foundation concrete on piles.
Superstructure steel filled in with paving brick.
Temporary end of sheet iron protected with asbestos. This end is painted and is built with a parapet to conform in appearance with the permanent construction. The temporary end can be moved.

Stack:

Custodis brick, 220 ft. high and 15 ft. inside diameter.

time the plant on loads of this kind has an output of 1,250,000 kw.-hr. per month. That there is a good diversity factor in the load is shown by data recently obtained. The peaks of the twenty-two substations for a single day

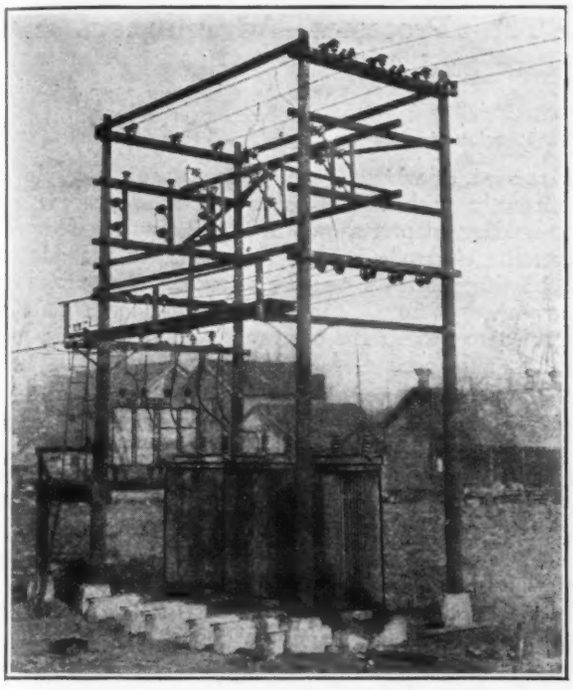


FIG. 7—STANDARD SUBSTATION SHOWING METHOD OF MOUNTING TRANSFORMERS ON STEEL RAILS LAID IN CONCRETE

were found to total 4451 kw. On this day the highest peak recorded by graphic instruments at the stations was 3000 kw., and this was of such short duration that the operators did not put the second machine on the line. The

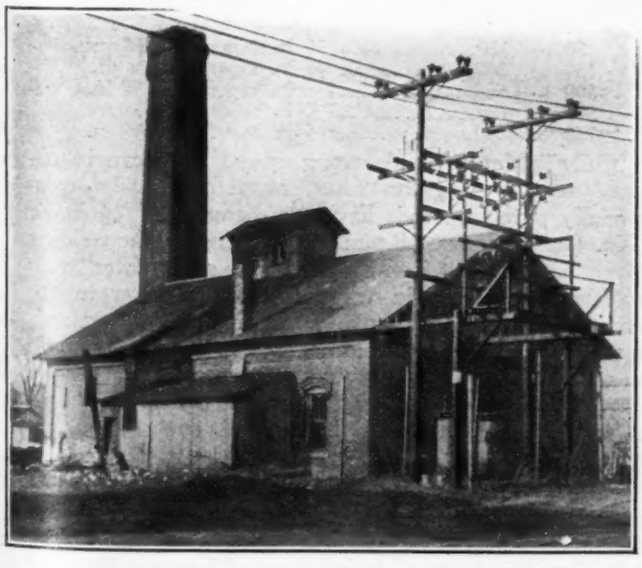


FIG. 8—ONE OF THE OLD STEAM PLANTS SHUT DOWN

entire load for that day was carried by a 2500-kva. unit. The present light-load conditions are not expected to obtain for long, because many of the large power users have just lately been connected. Among the power users is the American Mine No. 2, which is designed for a maximum output of 1000 tons per hour and which is probably destined to be the largest coal mine in the world. It expects soon to have its electric hoist in permanent operation. It has been estimated in fact that if this district in Indiana, with its potential coal output of 60,000 tons daily, were worked to its normal capacity, it would require 24,000,000 kw.-hr. annually just for mining operations alone.

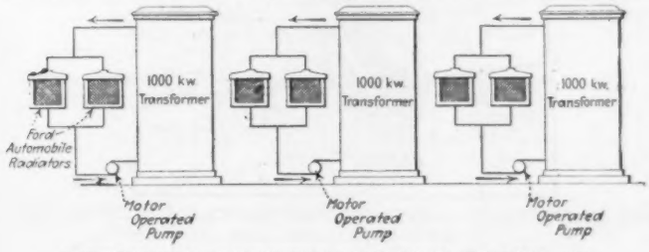
The Indiana Power & Water Company, which is owned by the Utilities Development Corporation of Chicago, has an investment in excess of $3,000,000 in this property. It is of particular interest, however, that a considerably greater expenditure than this was made by the mines and the industries in that district of Indiana to equip their workings to use electric power. The work which the Indiana Power & Water Company did in the territory was all accomplished under the direction of C. W. Humphrey, chief engineer and secretary of the Utilities Development Corporation of Chicago.

RATING OF TRANSFORMER BANK DOUBLED BY COOLING OIL

How Ford Radiators Were Used to Reduce Operating Temperature of Three 1000-Kw. Transformers on Heavy Overload

When it recently became unexpectedly necessary to increase the load on a bank of three 1000-kw. transformers at the Newnan substation of the Georgia Railway & Power Company, the unique scheme shown in the accompanying illustration for reducing the operating temperature was devised by H. L. Wills, electrical engineer, and G. A. Iler, superintendent of operation of the company.

The six Ford radiators were connected two in multiple to the transformer tanks by a 2-in. (5-cm.) pipe with a motor-driven pump installed near the bottom connection to each tank so as to draw the oil from the top of the tank through the radiators. In front of each radiator a 16-in. (40-cm.) desk fan was placed so as to blow a fine spray of water, provided by a spray nozzle also placed in front of each radiator, through its cellular construction.



AUTOMOBILE RADIATORS INCREASE RATING OF TRANSFORMERS

By this means a drop in temperature of 8 deg. through each pair of radiators was obtained and a load of 5000 kw. was carried on the three 1000-kw. transformers with an oil temperature of 60 deg. C. (140 deg. Fahr.) during summer weather. It is believed that the bank can be loaded to 6000 kw. In fact, it has carried the load of 5000 kw. every night for several months. The cost of the installation, aside from fans and motor-driven pumps taken from stock, was around $75.

Carbon-Electrode Arc Welding and Cutting

A Definite Outline of Welding and Cutting by Means of the Carbon Arc Is Offered to Aid in Clearing up Confusion and Uncertainty in These Processes—Advantageous Applications Are Enumerated

BY O. H. ESCHHOLZ
Research Engineer, Westinghouse Electric & Manufacturing Company

THE basic principles involved in the graphite-arc processes, as formulated by the author, are set forth in this article in the belief that they have not had sufficiently concrete treatment and that the development of methods of handling the work is too frequently left for the welder to work out. An understanding of these problems should greatly assist welders and result in a more intelligent application of the processes to practical foundry operations. This may be considered a companion article to "Training Arc Welders," which appeared in the ELECTRICAL WORLD for Sept. 27 and Oct. 4.

Welding.—Carbon or graphite electrode arc welding is perhaps the oldest of the electric fusion arc processes now in use, the Bernados and Olszewski patent having been granted in 1885. The original process consisted in drawing an arc between the parent metal and a carbon electrode in such a manner that the thermal energy developed at the metal crater fused together the edges of the joint members. This process was early modified by adding fused filling metal to the molten surface of the parent metal. Although both of these methods are similar in principle to fusion processes employing the oxy-acetylene

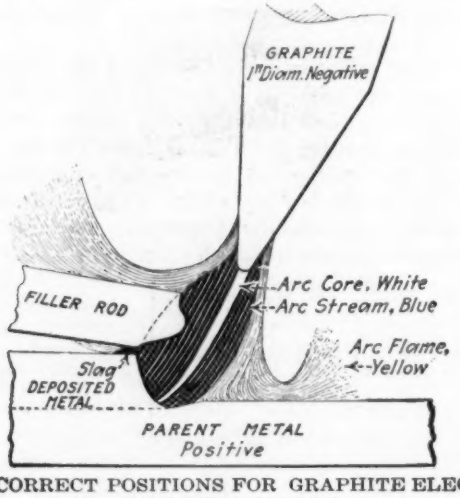


FIG. 1—CORRECT POSITIONS FOR GRAPHITE ELECTRODE AND METAL FILLER

flame, the absence of easily accessible information describing the necessary operations has limited their application. This discussion is designed, therefore, to supply the requisite information as well as to assist in the development of skilled operators.

Equipment.—This consists of a direct-current circuit possessing inherent means for stabilizing the carbon arc, a welding hood for each operator, an electrode holder that does not become uncomfortably hot in service and suitable clothing such as bellows-tongued shoes, gauntlets and apron of heavy material. When arc currents of less than 200 amp. are used, or when a graphite arc process is employed intermittently with the metallic electrode process, the carbon-holding adapter shown in Fig. 2 may be used with the metallic electrode holder, the shank of the adapter being substituted for the pencil electrode. With very high arc currents, 750 amp. or more, special holders should be constructed to protect the operator from the intense heat generated at the arc.

Electrodes.—Although hard carbon was originally employed for the electrode material, experience has shown that a lower rate of electrode consumption as well as a softer weld may be obtained by substituting graphite electrodes. While both electrodes have the same base and binder, the graphite electrode is baked at a sufficiently high temperature (2000 deg. C.) to graphitize the binder, thereby improving the bond and the homogeneity of the electrode. The graphite electrode is readily distinguishable by its greasy "feel" and the characteristic streak it makes on paper.

The diameter of the electrode is determined partly by the arc current. To fix the position of the carbon arc terminal, thereby increasing arc stability and arc control, all electrodes should be tapered. This precaution is particularly important when using low values of arc current or when maintaining an arc under conditions which cause distortion and instability. The following table gives electrode diameters in most common use with various arc currents:

Amperes	*Diameter*
50 to 150	¼ in. tapered to ⅛ in.
150 to 300	⅜ in. tapered to ⅛ in.
300 to 500	1 in. tapered to ⅛ in.
500 to 750	1¼ in. tapered to ⅛ in.
750 to 1000	1½ in. tapered to ⅛ in.

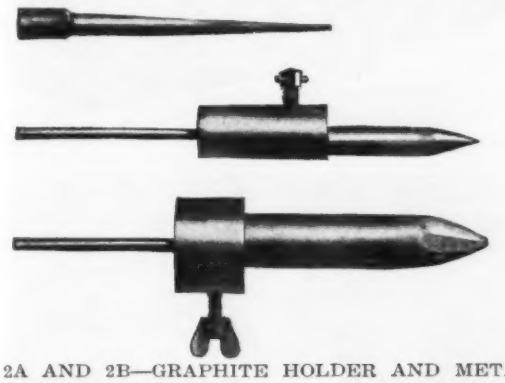
"Filler" Material.—A strong, sound weld can be obtained only by using for "filler" metal low carbon, commercially pure iron rods having a diameter of ⅜ in. or ½ in. (9.6 mm. or 12.8 mm.), depending on the welding current used. Cast iron or manganese steel "filler" rods produce hard welds in which the fusion between the parent and added metals may be incomplete. Short rods of scrap metal, steel turnings, etc., are frequently made use of for "filler" metal when the purpose of the welder is merely to fill a hole as rapidly as possible. It should be understood that welds made with such metal are weak, contain many blowholes and are frequently too hard to machine.

Operator Selection—It is as difficult for the user of graphite arc processes as it is for the oxy-acetylene welder to estimate the degree of fusion obtained between deposited and parent metals. Therefore the operator must follow conscientiously the correct procedure, recognizing that the responsibility of executing a faulty weld rests solely with himself. He should, of course, have a working knowledge of metals, must be able to distinguish colors and possess a

fair degree of muscular co-ordination, although the manipulative skill required is less than that necessitated by the metallic electrode process.

GRAPHITE ARC WELDING EMPLOYING A "FILLER"

Posture.—This operation is conveniently described as autogenous soldering. The correct posture is illustrated in Fig. 6. The filler rod is shown grasped by the left hand with the thumb uppermost. When held in this position the welder may use the rod to brush off slag from the surface of molten metal or to advance the rod into the arc stream.



FIGS. 2A AND 2B—GRAPHITE HOLDER AND METALLIC ELECTRODE HOLDER FOR LOW CURRENTS

Preparation.—The surfaces to be welded should be chipped clean. Where they are scarfed the angle should be wide enough to enable the operator to draw an arc from any point without danger of short-circuiting the arc. It is the practice of some welders to remove sand and slag from the metal surfaces by fusing them with the aid of the arc and then striking the fluid mass with a ball-peen hammer. This method should be discouraged since both operator and nearby workmen may be seriously injured by the flying hot particles.

Arc Manipulation—Starting.—The arc is formed by withdrawing the graphite electrode from a clean surface of solid metal or from the end of the filler rod when it is held in contact with the parent metal. If the arc is formed from the surface of the deposited metal or from that of a molten area, slag particles may adhere to the end of the electrode, deflecting the arc and increasing the difficulty of manipulating it.

Control of Arc Terminal.—By inclining the electrode approximately 15 deg. to the vertical the control of the position, direction and speed of the arc terminal is facilitated. When the electrode is held vertically irregularities in the direction and force of convection currents deflect the arc first to one side and then to another, causing a corresponding movement of the metal arc terminal. By inclining the graphite electrode the deflecting force is constant in direction, with the result that the electrode arc stream and arc terminal remain approximately in line, as shown in Fig 1, and may then be moved in any direction or at any speed by a corresponding movement of the graphite electrode.

Polarity.—It is common knowledge that the positive terminal of a carbon arc is hotter and consumes more energy than the negative terminal. If the graphite electrode of the welding arc is made the positive terminal, energy will be uselessly consumed and the resulting higher temperature will increase the loss of carbon through excessive oxidation and vaporization. Moreover, for reasons well known to those familiar with the phenomena of arc formation, a very unstable arc is obtained with the iron parent metal functioning as the negative electrode. The graphite electrode should therefore always be connected to the negative terminal, reversal of polarity being detected when the arc is difficult to hold and when the carbon becomes excessively hot.

Arc Length.—Even when the graphite electrode serves as the negative arc terminal, its temperature is great enough to cause the vaporization of a considerable quantity of carbon. If this carbon is permitted to be transferred to and absorbed by the fluid metal, a hard weld will result. To insure a soft metal practically all of the volatilized carbon should be oxidized. This may be accomplished by regulating the arc length so that atmospheric oxygen will have ample time to diffuse through the arc stream and combine with all of the carbon present. The correct arc length is dependent upon the welding current and the degree of confinement of the arc. Since the arc diameter varies as the square root of the current the arc length should be increased in proportion to the square root of the current. It is also obvious that when an arc is drawn from a flat, open surface the vaporized carbon is more accessible to the atmospheric gases than when it is inclosed by the walls of a blowhole. It is obvious that to secure the same amount of oxidized carbon under both conditions the confined arc should be the longer. Many welders are not familiar with this phenomenon, with the result that metal deposited in holes or corners appears to be inexplicably hard.

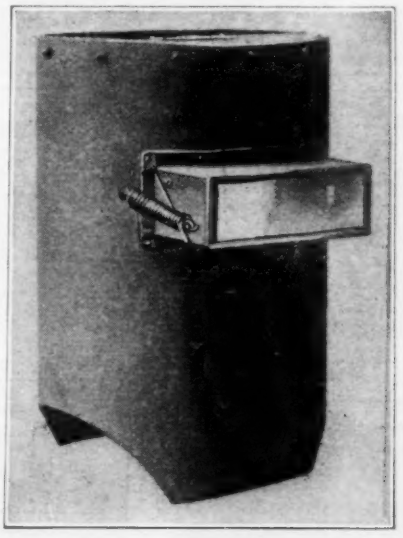


FIG. 3—PROTECTING FIBER HOOD FOR MAXIMUM COMFORT

The length of a 250-amp. arc should not be less than ½ in. (12.8 mm.), and that for a 500-amp. arc should not be less than ¾ in. (19.2 mm.) when drawing the arc from a flat surface. The maintenance of excessive arc lengths causes the diffusion, through convection currents, of the protecting envelope of carbon dioxide, with the result that the exposed hot metal is rapidly oxidized or "burned." For most purposes a 250-amp. arc should not exceed a length of 1 in. (25 mm.) and the length of a

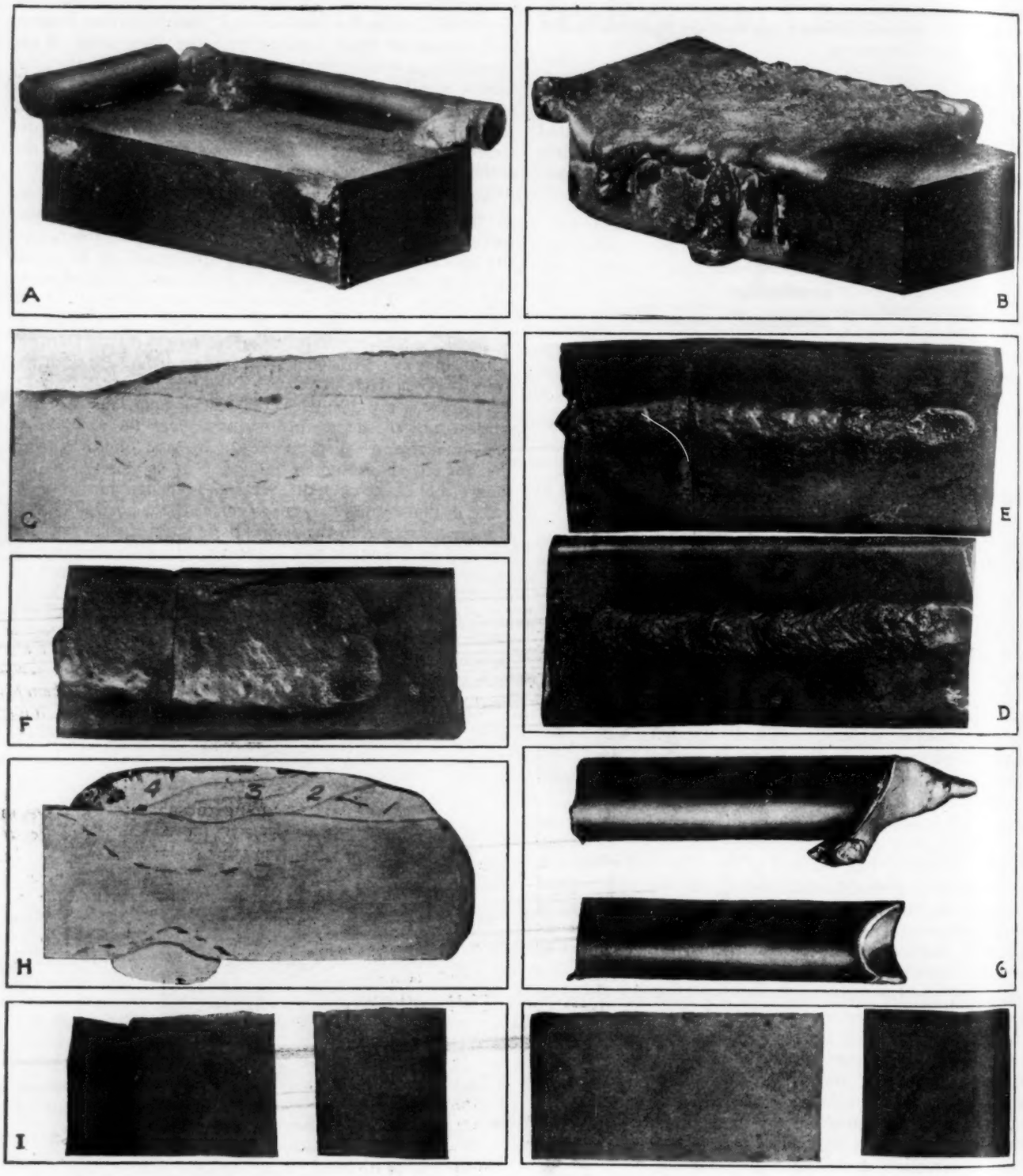


FIG. 4—METHODS OF DEPOSITING METAL IN GRAPHITE-ARC WELDING PROCESSES

A—Preparation of surface preliminary to the "building-up" process using sections of filler rod to indicate outline and height. B—Appearance of surface partly built up. Note slag adherence to side of plate. C—Section through metal deposited by "puddling process." Continuous line indicates union between deposit and parent metal; broken line, the depth of structural change. D and E—Appearance of filler metal when deposited in layers, as in the metallic electrode process before and after "surfacing." F—Area built up by abutting four layer deposits. G—Typical appearance of filler rod ends when correctly manipulated, concavity produced by shape of arc stream. H—Fusion between four layers and parent metal (upper) and single layer and parent metal with zones of thermal disturbances. I—Sections through graphite-arc weld indicating homogeneous metal and fusion at scarf surface (left), and sections through oxy-acetylene weld indicating homogeneous metal but less fusion of scarf.

500-amp. arc should not exceed 1½ in. (37.5 mm.). In view of the large variation permissible, the welder should be able to maintain an arc length which assures a soft weld metal with but little slag content.

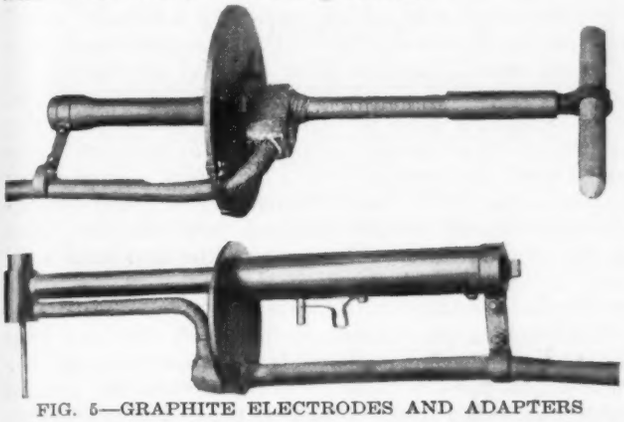


FIG. 5—GRAPHITE ELECTRODES AND ADAPTERS

Fusion Characteristics.—The arc serves to transform electrical energy into thermal energy. The energy developed at the metal terminal or arc crater is utilized to melt the parent metal, while that generated in the arc stream serves to melt the filling material. If the molten "filler" is not properly guided and, as a consequence, overruns the fused parent metal, a poor weld will result. This process necessitates, therefore, a constant observation of the distribution of the fused metals as well as a proper control of the direction of flow and speed of deposition of the filling metal.

There are two methods in use for adding the "filler" with a minimum overlap. The best known has been named the "puddling" process. It consists in melting a small area of the parent metal, thrusting the end of the "filler" rod into the arc stream, where a small section is melted or cut off, withdrawing the rod and fusing the added material with the molten parent metal by imparting a rotary motion to the arc. This puddling of the metals serves also to float slag and oxidized material to the edge of the fused area, where they may be brushed or chipped off.

A method for facilitating the rapid building up of a surface by this process is shown in Fig. 4A. The short sections of filler rod were welded to the sides of the casting in order to prevent the molten material from overflowing and to indicate the required height of the addition. The appearance of the nearly completed "fill" is shown in Fig. 4B. One side of the added metal is lower than the others to facilitate the floating off of the slag, some of which may be observed adhering to the edge of the plate. Fig 4C shows a section through a weld produced in this manner, the continuous line indicating the zone of fusion and the broken line the boundary of crystal structural change produced by the temperature cycle through which the parent metal has passed as a result of the absorption of the arc energy.

Some users of this process advocate puddling short sections of the filler rod, 1 in. (25 mm.) to 3 in. (75 mm.) in length, with the parent metal. Where this method is followed, the "filler" may be incompletely fused and therefore not welded to the surface of the parent metal.

In the second and less known method of autogenous soldering with the graphite arc, the "filler" material is deposited in layers, as shown in Fig. 4 (D, E and F), the deposits being similar to those obtained with the metallic electrode process but wider and higher. This method simply requires the operator to feed the filling rod continuously into the arc stream so that the molten "filler" deposits on the area of parent metal fused by the arc terminal while the arc travels across the surface. If the end of the rod is moved forward while resting on the surface of the newly deposited metal, most of the slag produced by the oxidation of the hot metal is floated to the sides of the deposit, where it may be brushed or chipped off. The appearance of fused filler rod ends when correctly manipulated is shown in Fig. 4G. Slag may be observed still adhering to the bottom of one of the rods.

Fig. 4 (D, E and F) illustrates the appearance of typical layers formed when using a welding current of 250 amp. with a filling rod ⅜ in. (9.6 mm.) in diameter. The fusion between parent and added metal is shown in Fig. 4H. Fusion between the parent metal and four layers of added metal is shown at the upper surface of the exhibit. To remove slag or improve the appearance of the deposits the surface of the added metal may be remelted by running the arc terminal over it, provided "burning" and hardening of the metal is avoided. Fig. 4 (D and E) illustrates the appearance of deposits before and after the surfacing operation.

Thermal Disturbance.—The energy absorbed by the welded structure tends to produce internal expansion and contraction stresses. The rapid cooling of hot metal adjacent to the welded area tends to cause the formation of a hard and brittle zone. To avoid either of these effects the object welded should be heated before welding and annealed afterward. The necessity for adopting this precaution fortunately rarely occurs, since the area welded must form a large part of the structure or the carbon content of the metal will exceed 0.3 per cent.

The expedient of hammering or swaging the hot deposited metal is frequently resorted to where a refinement in the structure of the crystal grains is desirable.

EDGE OR STANDING SEAM WELDING

Fig. 7 illustrates a useful application of the original carbon-arc process wherein no filler metal is used, the

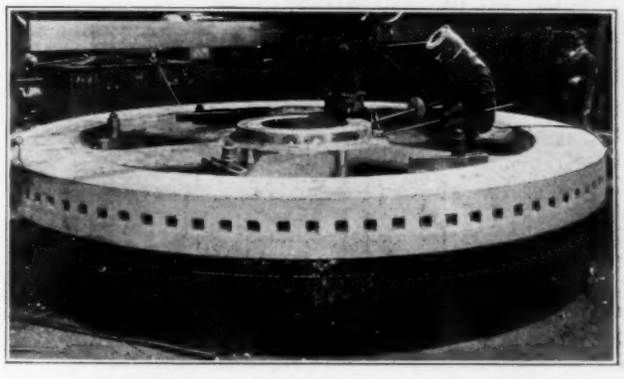


FIG. 6—CORRECT WELDING POSTURE

metal-arc terminal serving to melt together the sides of the weld. Fig. 8 illustrates the fusion secured, the metal at the upper end of each standing edge having been united into a homogeneous mass.

This process is easily performed. To obtain adequate fusion the arc current selected should have such a value

that the metal-arc crater nearly spans the edges of the seam. To assure the maintenance of a stable arc a small, tapered electrode should be employed, as shown in Fig. 2A, the diameter of the electrode end remaining less than ⅛ in. (3.2 mm.) during use. The process may be adapted to the automatic welding of long seams.

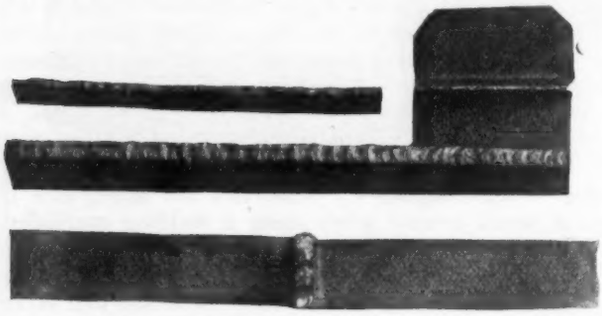


FIG. 7—EDGE OR STANDING SEAM WELDS

This graphite arc process is used occasionally to form butt and lap welds by melting together the sides of the joint without the use of "filler" metal. Examination of sections through joints made in this manner reveals that the weld is very shallow and therefore weak.

Cutting

The manipulation of the cutting arc is exceedingly simple, the operator merely advancing the arc terminal over the section to be cut at a rate equal to that at which the molten metal flows from the cut. The cutting speed increases with the value of arc current used. The width of the cut increases with the arc diameter and therefore as the square root of the arc current. Fig. 9 shows the appearance of cuts made in ship steel plate ½ in. (12.5 mm.) thick. The following data apply to Fig. 9:

Position of Cut	Amp.	Width, in.	Length, in.	Time, min.
Upper	250	0.5	8	2½
Lower	650	0.8	8	1

Before cutting the plate the welder outlined the desired course of the arc by a series of prick punch marks, the indentations being plainly visible in the light radiated from the arc. When cutting deeper than 4 in. (10 cm.) the electrode should not come in contact with the walls of the cut and thereby short-circuit the arc.

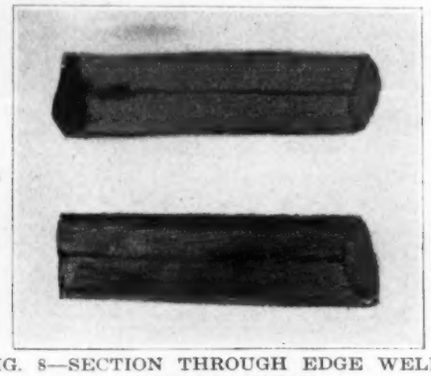


FIG. 8—SECTION THROUGH EDGE WELDS SHOWING UNION

This process may be used for cutting both ferrous and non-ferrous metals. It has found a particularly useful field in the cutting of cast iron, an operation to which the oxy-acetylene flame cannot be adapted. It is often used for the "burning" out of blast-furnace tap holes and the melting or cutting of iron frozen in such furnaces.

Welding of Non-Ferrous Metals

Although this art is still in the experimental stage, present indications are that it will have a large commercial use. Copper and bronzes have been successfully welded with the graphite arc when employing a bronze "filler" rod low in tin and zinc and high in phosphorus, at least 0.25 per cent. The best filler material for the various analyses of parent metals has not been determined, but it is recognized that the presence of some deoxidizing agent such as phosphorus is necessary in order to insure sound welds free from oxide and blowholes. Since copper and its alloys have a high thermal capacity and conductivity, preheating of the structure facilitates the fusion of the joint surfaces. The grain of the completed weld may be refined by subjecting the metal to a suitable mechanical working and temperature cycle.

Low-melting-point metals such as lead may be welded by holding the graphite electrode in contact with the surfaces to be fused without drawing an arc, the current value used being sufficient to heat the end of the carbon

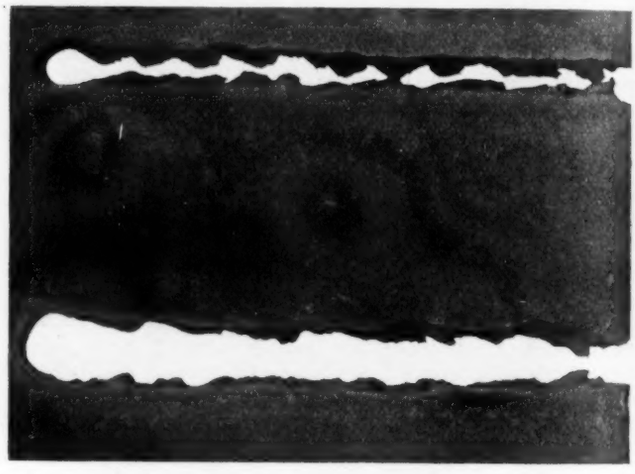


FIG. 9—APPEARANCE OF ¼-IN. SHIP PLATE CUT WITH GRAPHITE ARC

to incandescence. The hot electrode tip may also be used to melt the filler rod into the molten parent metal.

Application

The graphite arc processes may be used to particular advantage for the following purposes:

(1) Welding of cast iron, cast steel and non-ferrous metals.

(2) Cutting of cast-iron and cast-steel risers and fins and non-ferrous metals.

(3) Rapid deposition of metal to build up a surface or fill in shrinkage cavities, cracks, blowholes and sand pockets where strength is of minor importance.

(4) Fusion of standing seams.

(5) Melting and cutting of scrap metal.

(6) Remelting of a surface to improve its appearance or fit.

(7) Preheating of a metal structure to facilitate the welding operation, to reduce locked-in stresses or to alter some dimension.

(8) Deposition of hard metal or the hardening of a surface by the inclusion of vaporized carbon, such as rails, frogs and wheel treads.

(9) Automatic cutting and welding of sheet metal.

Readers' Views and Comments

"Equivalent Hours" in Studies of Lighting and Power Loads

To the Editor of the ELECTRICAL WORLD:

SIR: In the May 3, 1919, issue of the ELECTRICAL WORLD, in commenting on two articles by the writer on the "Determination of Economical Power Circuits," published in the ELECTRICAL WORLD for May 25, 1918, and March 8, 1919, W. F. Butcher discusses fully the determination and use of "equivalent hours." His general method of attack is quite similar to the one used in determining the equivalent hours for residence lighting in an article published in the ELECTRICAL WORLD, Dec. 15, 1917, under the title of "Determination of Economical Feeder Sizes."

In this problem, involving residence lighting only, the "equivalent hours" were computed, taking into consideration the relations of the monthly peak each month to the yearly peak and the average daily peak during the month to the monthly peak. The "equivalent hours" thus obtained are between two and two and one-half for the various conditions. However, having in mind the accurate method previously referred to in the determination of "equivalent hours" for the power load, the approximate method of taking an average of two representative days in each month was thought sufficient for the following reasons:

1. The power lines in this system carry an exceedingly small amount of lighting load, not enough nor of such character as to affect the peak.

2. The maximum power load for an average day does not have a sharp peak, but the load curve is comparatively flat for the heavy-duty hours of the day.

3. There is very little seasonal variation, the characteristic daily curve and daily maximum remaining practically the same throughout the year except for the rise due to natural increase in load. On a system as a whole this increase would be cared for partly by new lines and would not be exactly characteristic of any particular line.

In regard to the use of 300 days, it was found that the Saturday load was practically the same as on other days since few of the large plants close on that afternoon. The use of 300 days per year allows for the omission of Sundays and holidays. No justification is seen for spreading the load over 365 days in computing "equivalent hours" for power.

The power conditions studied in the article referred to are perhaps different from those that will be found in many localities, on account of the heavy concentration of industries and the number of plants working the full twenty-four-hour day. The "equivalent hours" would therefore probably be somewhat higher than might be found in other cities. However, Mr. Butcher's figure of 3.4 "equivalent hours" seems exceedingly small for any pure power load. Possibly his lighting load has considerable effect on his peak.

The item of "equivalent hours" is a very indeterminate quantity at best. Its value and the method of obtaining it depend very largely on local conditions and upon what use is to be made of it. For that reason it is essential that it be worked out independently to fit the conditions under which it is to be used. Where there are high peaks and low minimums and marked seasonal variation, as in pure lighting load, the problem requires a very careful analysis. Where the load is nearly constant, however, more approximate methods are justified.

P. O. REYNEAU,
Distribution Engineer, Detroit Edison Company.
Detroit, Mich.

Fuel Oil Steam-Electric Generation

To the Editor of the ELECTRICAL WORLD:

SIR: War-time experiences in power generating brought to light many new and interesting economies. Coal production was increased and its use carefully conserved to a degree hitherto thought impossible of attainment. Hydroelectric generation by means of interconnection was vastly forwarded in stabilizing continuity of service and in borrowing power from neighboring companies when savings could be effected in storage and other means of conservation.

When all is said and done, however, it is doubtful if greater proportionate results were attained in economies during the thrills of the war period than those which were brought about in the steam-electric power plants operated by fuel oil. While it is true that actual efficiencies were vastly forwarded to such a degree that one well-known power plant in Arizona under test conditions registered an economy of 333.3 kw.-hr. per barrel of oil, yet it is to be said to the credit of power-plant operators generally that the real savings were accomplished more by careful and painstaking observations of sensible and well-drawn rules for power-plant operators, which were aided and forwarded by the various state federal fuel administrators, than by any other means of conservation.

In California these aids proved to be of unusual helpfulness. A number of well-known engineers were called in by the California federal fuel administrator to assist in formulating rules for economic operation of steam-power plants when oil-fired. As a result rules were sent out to all power plants using fuel oil in California and neighboring states. After nearly two years of try-out these rules have required but slight modification.

Great emphasis is to be laid upon the necessity of each power-plant operator finding for himself the best furnace arrangement and draft suited to his particular installation. And above all it has been shown in war-time experience that delicate tests are not so necessary in determining the economic adjustment as is a wholesome common-sense balance in judgment concerning the fundamental factors involved in every-day operation.

San Francisco, Cal. R. O. B. SIBLE.

An Afghanistan Hydroelectric Plant

To the Editor of the ELECTRICAL WORLD:

SIR: In supervising the construction of a 1500-kw. hydroelectric plant 50 miles (80 km.) north of Kabul, at Jabl-us-Siraj, Afghanistan, the writer had some peculiar experiences in transporting material and carrying on the construction work that may be of interest to other engineers who may have to design, equip or erect a plant in a foreign country. The equipment was purchased from an

English firm and shipped to Bombay, which is 1750 miles (2800 km.) from the site of the plant. Railroads from Bombay did not permit getting closer than Peshawar, which is 250 miles (400 km.) from the plant site. When the writer reached India a large part of the equipment had arrived at the rail end, and most of the remainder was on the way or in process of manufacture, so there was no opportunity to make any changes in the layout that were afterward found to be necessary.

Owing to the fact that the route from the rail end to the plant site lay through the Khyber Pass loads could be taken only part way in the fall. There being no towns beyond Jellalabad, the cargo had to be left at some "sari" until spring because of the snow. Nearly every conceivable form of transportation was employed—pack horses, camels, bull carts, elephants, etc. The heavy pieces were hauled on heavy trucks drawn by elephants, of which nine were available. It took these three months or more to make a round trip, and they could not be used in the winter on account of the cold. On the other hand, the camels could not be used in the hot months, because there is a fly in the Jellalabad district that kills them off. The cost of transport, including graft, was equal to first cost of the plant.

ERECTING TRANSMISSION TOWER

ELEPHANTS USED TO TRANSPORT MATERIAL FOR POWER PLANT

Transportation problems only started the trouble which was to follow. Whereas the time which had been estimated for constructing the canal, which is 1½ miles (2.4 km.) long, was forty-six days with 100 men, it actually turned out that 500 men required three years to finish it. It was located on the side of a hill about one-third of its length, the hill having a slope of one to one. Besides, there were many big boulders that had to be blasted, and the whole hillside had to be shifted, a quarter of a million cubic yards of soil being moved by hand labor. The laborers sent were equipped with wooden shovels, and most of them were not accustomed to this kind of work, being weavers.

Another thing that delayed the construction of the canal was the fact that it followed the site of an irrigation ditch, the flow of which could not be interrupted. Hence a second ditch had to be constructed to carry the irrigation water while the power canal was being excavated. Boulders weighing up to a ton were hauled out by elephants while larger ones were blasted. One elephant was able to handle more stone than fifty men. Deflecting the river into the canal was rather difficult, because no pump was available nor was there any wood with which to build cofferdams or flumes. Furthermore, cement delivered at the site cost $5 per cubic foot ($178 per cu. m.). The masons were accustomed to building with mud and hence had to be closely watched to prevent their handling the cement in the same way and to make them economical in the use of mortar. Labor was difficult to hold, because the masons received only 30 to 40 cents a day and ordinary labor only $1.60 per month. It was necessary to dig a new channel for the river (a torrential stream) to turn it from the power house site. This was a four months' job.

Local bricks and lime were of very poor quality; bricks left out in the rain soon became a shapeless mass of clay, and lime was slacked, full of stones and adulterated with earth. Condemned bricks and lime sent away one day came back the next. Because thorny scrub was about the only combustible material available, it was very difficult to burn bricks and lime properly.

The transmission line had to be resurveyed and located. The iron for the steel towers was distributed by camels and elephants. At first it was intended to assemble the towers on the ground and raise them with a derrick in the usual way, employing elephants instead of horses, but it was found to be safer and cheaper to build them in position. At first the work went a bit slow, but after a couple of weeks a crew of six men could erect two towers per day, at a labor cost of 48 cents per tower. The only apparatus used included a light 20-ft. (6-m.) pole lashed to one corner angle and two planks laid across a tower angle on which to stand. The wire was all tied to the insulators by Europeans, because the natives could not be trusted.

Labor was so cheap that it was very expensive. Skilled labor, native or European, was hard to obtain and hard to hold. Many other difficulties arose which made it seem sometimes that the plant would never be completed, but the foregoing gives some indication of the troubles of building a plant in an isolated foreign country with no railroads, little wood and no modern conveniences.

Fresno, Cal. A. C. JEWETT.

STATION & OPERATING PRACTICE

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

MEASUREMENTS OF GOOD AND OF INFERIOR CABLE

Relative Values of Different Grades of Insulated Cable Can Be Determined by Gaging Power Factor and Dielectric

Since dielectric loss and power factor in insulated cable vary only with change in frequency, voltage, temperature and deterioration, comparisons of these two quantities under the same frequency, voltage and temperature are very good measures of relative cable values. Of course, the loss will vary with the size of the cable (although power factor does not), so cables of similar size should be compared. The accompanying table indicates the power factor and dielectric loss at different temperatures for samples of relatively good and poor cable. The poor cable was six years old.

COMPARISON OF GOOD AND POOR CABLES

Temperature, Deg. C	Power Factor, Per Cent	Dielectric Loss, Watts	Power Factor, Per Cent	Dielectric Loss, Watts
20	1	0.05	10	0.5
40	7	0.15	20	1.0
60	10	0.30	35	2.5
80	15	0.50	59	6.0
100	20	0.70	73	13.0

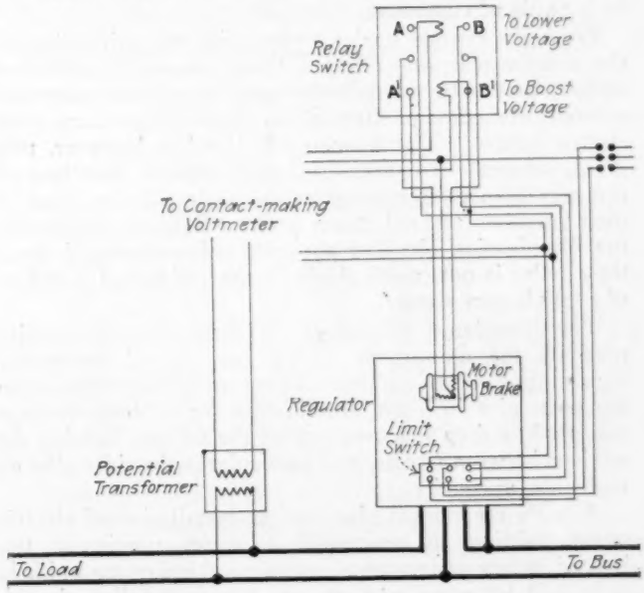
This information was presented by W. S. Clark before a recent meeting of the New England Section of the National Electric Light Association.

POOR RELAY CONTACT CAUSES DROP IN FEEDER VOLTAGE

Voltage on One Phase Lowered About 10 Volts for Several Minutes, Then Returning to Normal —Explanation of Trouble

From the chart of a recording voltmeter on one of its feeders a central-station company in the West observed that the voltage on one phase would drop about 10 volts to 12 volts (118 to 108) and remain at this value for intervals varying from five to ten minutes before returning to normal. An investigation of the induction regulator showed that the relay switch was making good contacts at A and B for lowering the line voltage, but a poor contact at B^1 resulted in the motor operating single-phase through contact A^1. The contact-making voltmeter was set for too fine an adjustment, and the operating motor overran the braking mechanism. A rise in voltage on the line would cause the regulator to operate in the voltage-lowering direction. With the motor started in that direction it would overrun the neutral point, so that the contact-making voltmeter would attempt to raise the voltage again. The relay would be pulled to contact at A^1, and the motor, which was already running in a lowering direction, would continue in that direction, operating single-phase, until stopped by the limit switch. The regulator would remain in this position of minimum voltage until a vibration of any kind shook the contact together at B^1, when the regulator would return to neutral position.

Apparently the trouble should have been easy to locate



CONNECTIONS OF INDUCTION REGULATOR

in the poor contact at B^1, but as this occurred only at infrequent intervals it was difficult to find. The origin of the difficulty was probably the formation of a scale over the face of the carbon contacts.

C. B. MERRICK.

ADAPTING GAS-LAMP POSTS FOR ELECTRIC LIGHTING

One Method of Providing Electric Street Lighting Without Incurring High First Cost Where Gas Has Been Used

Replacement of gas lamps which still survive by electric lamps offers almost as many obstacles as does the initial installation of a sastifactory and economical system of electric illumination in districts previously unlighted. In many of these localities the advantages of interior electric lighting have not, in the real estate owners' opinions, balanced the cost of wiring finished buildings. Permanent pavement has already been laid without provision for electric services, either underground or overhead, whereas gas street lamps are already in existence.

In other and newer districts electric service is brought in from avenue blocks by means of back-yard construction on poles. In other localities old and new, and much

against the real estate owners' will, pole lines have been erected along the curb line and the service has thus been extended.

In the first case the revenue accruing from the installation of interior wiring in the few houses where the owners realize the advantage of electric lighting does not pay the interest on the investment required to lay underground mains, particularly where permanent pavement must be restored after excavation. Nor do the indications prove that sufficient energy will ever be consumed in the older residential districts to warrant the laying of mains in anticipation.

In the newer districts of the semi-suburban class, and particularly the so-called restricted districts, somewhat similar conditions have led the central stations to extend their lines by means of a construction leading into the back yards of customers.

From the central station's viewpoint the utilization of the wooden-pole line offers a cheap means of extending service, and such construction also affords an easy and economical method of supplanting the street gas lamp with electric lamps. The wooden-pole line has, however, two disadvantages—first, there is a well-founded objection of property owners to having an unsightly pole in front of their premises; second, from a street-lighting standpoint, the illumination obtained through units suspended from these poles is not, particularly in the residential districts, of a satisfactory nature.

The abundance of foliage in these districts usually prevents the use of the widely spaced and necessarily highly hung electric units. These units suspended from the poles give brilliant illumination for a short distance and produce deep shadows back of the foliage, lighting the sections between streets, and particularly the sidewalks on each side, unequally.

A fairly economical plan for the installation of electric street lighting in residential localities previously unlighted, where underground commercial mains are unlikely to be laid for many years if ever, has been followed with much success in some parts of New York City. Ornamental electric lamp posts, approximating the gas post in size and shape and spaced and arranged in staggered alternation on both sides of the street in the same manner, are erected. Service to these posts is afforded by means of armored weatherproof cable, laid from the nearest electric main and about a foot below the earth's surface. Where permanent pavement has previously been laid the cable is placed just inside the curbing, and where the street is unimproved the cable may be placed close by and outside of the curb.

This arrangement provides a permanent electric lighting equipment, giving a uniform illumination obstructed only by tree trunks; the shadows thus formed are effectively broken up by the staggered arrangement of the posts. The property owner is pleased by the absence both of wooden poles and of the dazzling high-candlepower lamp which was a necessity with wider spacing.

The gas-lamp post is not essentially different from the type of electric lamp post just described. The size and shape of both are almost identical, the subsurface structures are similar, and the head of the gas post may easily be adapted to hold the lantern-type fixture.

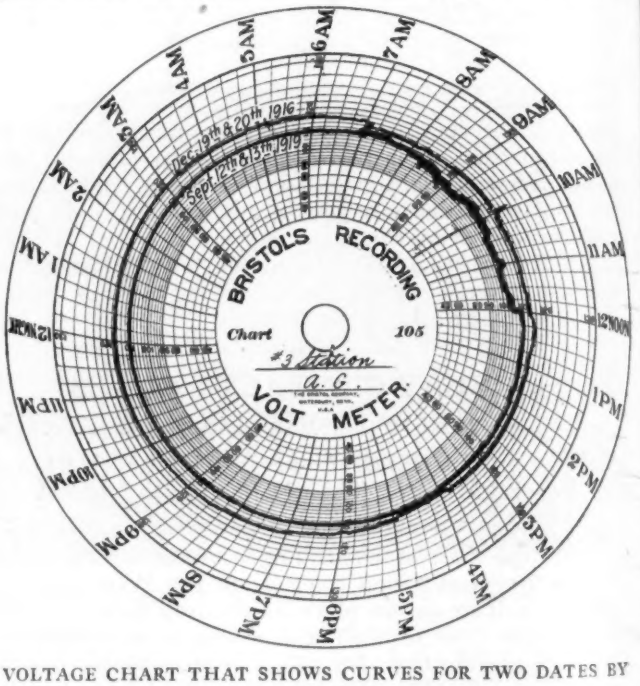
The electric post has installed within it a fuse block and switch, accessible by means of a door fitted to its butt a foot or so above the surface of the ground. This is the only feature which differs essentially from the gas post and the only thing which offers an obstacle to the utilization of the latter for electricity.

It is the opinion of the writer that the gas-lamp post could be converted at small expense. Replacing the gas service pipes, the cable could be brought up to a point at the butt of the post. At this point a hole could be drilled large enough for the admission of the cable to a box containing a fuse block and switch, provided with a lock and bolted to the exterior of the post. This method of installation would increase the illumination of the street without sacrificing the uniformity of distribution and it would reduce the maintenance cost.

RECORDING-INSTRUMENT CHARTS USED TWICE

How One Chart Is Used to Compare Operating Conditions at Different Periods with a 50 per Cent Saving in Charts

J. J. Borger, superintendent of the electrical department of the Augusta-Aiken Railway & Electric Corporation, Augusta, Ga., has found it convenient to use each chart on recording instruments in generating stations twice. When the charts are used the first time the curve drawing pen is filled with red ink. This chart when removed is



VOLTAGE CHART THAT SHOWS CURVES FOR TWO DATES BY DIFFERENTLY COLORED INK

filed and at a later date used again by filling the curve drawing pen with green ink.

Besides saving one-half the number of charts otherwise required, this scheme makes it possible to obtain and file comparison records of the operating conditions at a station for different periods. A voltmeter chart that has been used twice, with red and green inks, is shown in the accompanying illustration.

This particular record shows that a voltmeter chart can be used over again on a circuit with a variation in voltage as close as 10 and both the new and old curves be entirely legible.

INDUSTRIAL APPLICATIONS

The Economical Utilization of Electrical Energy in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

FUSE-TESTING DEVICE IS USED FOR TESTING LAMPS

Simple Improvement on Method Previously Described in "Electrical World" Provides Easy Method of Testing Plug Fuses and Lamps

By simply soldering a piece of copper on the end of metal strips used for testing knife and cartridge fuses as described on page 304 of the Aug. 9, 1919, issue of the ELECTRICAL WORLD, the author has been able to utilize the devices for testing lamps and plug-type fuses.

This piece of copper is attached to the end of one of the original strips so that the tip of the lamp or plug-type fuse can rest on the second strip while the side of the plug will touch the first strip. Of course the two strips will have to be arranged so that the smallest distance between them is not greater than one-half the diameter of the plug of the lamp or fuse.

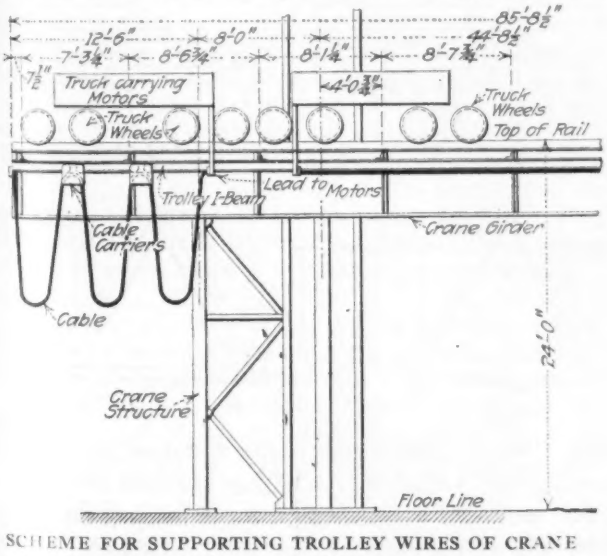
The piece which is soldered on the strip is 1 in. (25 mm.) long and ¾ in. (19 mm.) in height. Its width, naturally, is the same as that of the strap.

Detroit, Mich. A. N. SIMMONS.

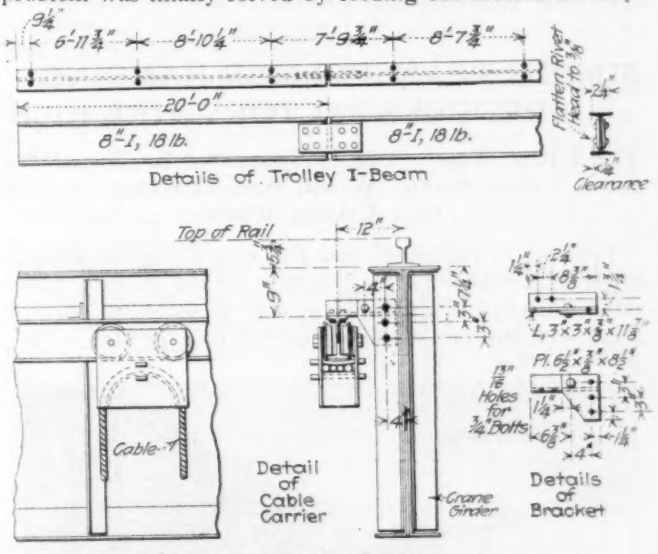
FLEXIBLE CABLES USED FOR CRANE POWER FEEDERS

They Solve the Problem of Supplying Energy to Crane Motors Where Overhead Trolley System Is Impracticable

When installing a manipulator crane beneath and at right angles to an overhead traveling crane in the forge shop, the Erie (Pa.) Forge & Steel Company found that the ordinary trolley system would interfere with the traveling crane operation. It was also impracticable to attach the trolley wires to the frame of the crane. The problem was finally solved by feeding the motors directly



SCHEME FOR SUPPORTING TROLLEY WIRES OF CRANE WHEN ORDINARY METHOD COULD NOT BE USED



CONSTRUCTION OF SPECIAL SUPPORT FOR FLEXIBLE CABLE FEEDING CRANE MOTORS

by a flexible cable. Ordinarily this cable would be difficult to handle because the crane moves back and forth very rapidly, but suitable cable supports which eliminate this objection have been made. These cable supports consist of double-wheeled carriages which hold the cable and which are free to move on wheels along an I-beam held on the crane frame by means of brackets.

As the crane moves away from the side of the shop, these cable supports automatically distribute themselves along the steel runway. The cable is made long enough so that it will be horizontal when the crane truck is at its greatest distance from the end of the frame.

CONSUMPTION OF ENERGY FOR INDUSTRIAL HEATING

Comparative Costs of Electricity and Other Fuels —Energy Consumption of Different Heat-Treating Processes

On the average a kilowatt-hour will heat about 5 lb. (2.2 kg.) of steel rivets when the current is passed through the rivet, according to C. A. Winder of Schenectady, N. Y., who gave these figures before the annual convention of the Association of Iron and Steel Electrical Engineers. He said further that a kilowatt-hour will treat about 10 lb. (4.5 kg.) of steel at about 1800 deg. Fahr.

(1000 deg. C.) in a well-insulated electric heat-treating furnace.

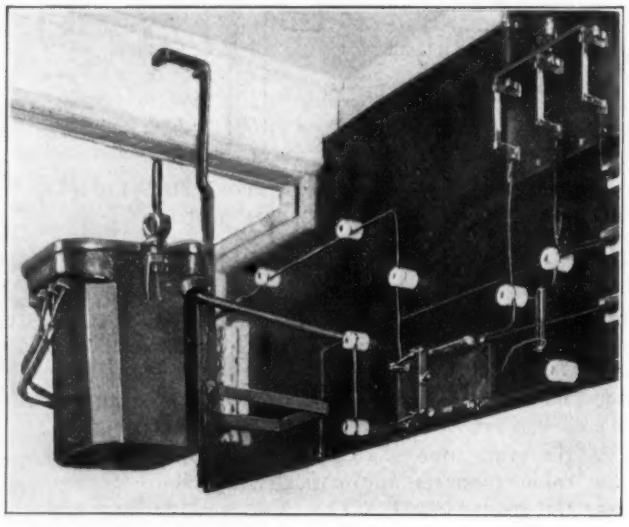
For heating enameling ovens electric energy at 2.4 cents per kilowatt-hour has been found equal in cost to gas at 80 cents per 1000 cu. ft. ($2.85 per 100 cu. m.) by several automobile manufacturers, who have taken into consideration the saving in labor, reduction in rejects and the quality of the product.

Brass which can be melted with 300 kw.-hr. per ton (330 kw.-hr. per metric ton) would require, on an average, about 55 gal. (220 l.) of fuel oil with 155,000 B.t.u. per gallon (10,000 cal. per l.) or 17,000 cu. ft. (480 cu. m.) of gas containing about 600 B.t.u. per cubic foot (5300 cal. per cu. m.).

SIMPLE TRANSFORMER HANGING REDUCES FACTORY FIRE RISK

The 2-Kva. Trasformer Is Supported by Two Vertical Straps Which Are Attached to a Ceiling Beam

In order to reduce the fire risk to a negligible amount at the Cambridge (Mass.) factory of the Rawson Electrical Instrument Company it was necessary to hang a 2-kva. transformer supplying energy to a group of 110-volt, single-phase motors 14 in. (35 cm.) clear from the switchboard. Part of the motors here are operated on 550 volts, three-phase service, the 550-volt group being fused separately. The main three-pole switch at the top of the board controls all motor service which is fused at the top of the board. A single-phase tap circuit runs to the transformer primary, with fuses and switch, and the local 110-volt motor circuits are fused by plugs mounted behind the transformer.



TRANSFORMER HUNG FROM FLOOR BEAM AND CLEAR OF SWITCHBOARD

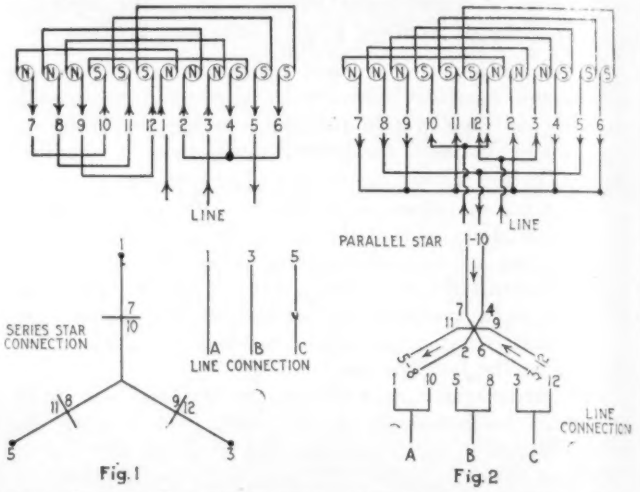
The transformer is hung by $\frac{5}{16}$-in. by 1¼-in. (8-mm. by 31-mm.) vertical straps offset and bent to hang upon two $\frac{7}{16}$-in. (11-mm.) steel pins driven through the roof beam, and the lower portion of the hangers is horizontally braced against the switchboard panel by ¼-in. by 1-in. (6-mm. by 25-mm.) straps. This arrangement provides ample ventilation for the transformer and convenient wiring for the switch and fuse installations.

Cambridge, Mass. A. J. Lush.

INDUCTION MOTOR CONNECTED FOR DIFFERENT VOLTAGES

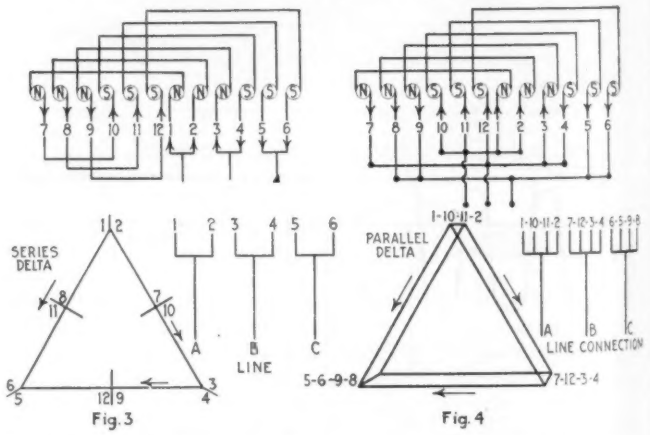
Simple Method of Connecting and Marking Leads of Three-Phase Motor So that It Will Operate in Any One of Four Ways

How to reconnect motors for different voltages without entirely rewinding them is a problem that is ever before the motor repair man. The accompanying diagrams show a simple method whereby a three-phase induction motor may be connected for different voltages. Each coil represents a group and only four poles are shown.



FIGS. 1 AND 2—SERIES-STAR AND PARALLEL-STAR CONNECTIONS OF THREE-PHASE INDUCTION MOTOR

In Fig. 1 the series-star connection is shown as the motor should be actually and schematically connected. By connecting the coils as shown, the line connections will be 1, 3 and 5. Likewise for the parallel-star connection



FIGS. 3 AND 4—SERIES-DELTA AND PARALLEL-DELTA CONNECTIONS OF THREE-PHASE INDUCTION MOTOR

a line wire will be connected to a common point of the three following groups: 1-10-11-12, 7-12-3-4 and 6-5-9-8.

Bridgeport, Conn. C. A. Aubrey.

CENTRAL STATION SERVICE

A Department Devoted to Commercial Policy and Management Topics, Including Methods for Increasing the Use of Electric Light, Power and Heat

THE CENTRAL STATION'S PLACE AS A MIDDLEMAN

It Stands Between the Coal Pile and the Light and Power Supply in Providing an Essential of Modern Life

BY "KASSANDRA"

When the consumer wants to blame somebody he seldom blames the producer but picks on the middleman. When the producer is attacked he will never admit that he is at fault, but it is always the poor middleman who is blamed.

What would happen if there were no middlemen? What hid happen when there were no middlemen?

Once the farmer raised his sheep and sheared the wool; then his wife and daughters spun the yarn and wove the cloth and made the suits of clothes. Why not go back to that happy state of affairs? In those days there were no towns and no roads for there was no need of them. Unless the farmer could raise something himself or swap with a neighbor he had to get along without.

We should remember that roads, towns, telegraphs, mails, newspapers, wagons, railroads and electric light wires are nothing but tools of middlemen. How often do we remember that the people who provide and operate all these essentials of modern life are the middlemen?

The railroad man thinks of himself as a consumer (which he is) and as a producer of transportation (which he is), but why doesn't he remember that he is also a middleman? The butcher, the baker, the candlestick maker are all middlemen.

The central station is essentially a middleman, and if any think of blaming the middleman just let them stop and think of all that the central station has accomplished and how little it has received in return. Its stockholders have received no more than they could have obtained for their money in other business, and its employees are certainly not overpaid for the work they do.

We should not blame the middleman, because in fact nearly every one is a middleman. The farmer puts in one bushel of seed and his crop is twenty bushels. This is 1900 per cent profit. Should he not be blamed rather than the other middleman who takes so much smaller a percentage?

When the muckrakers or the politicians raise a cry of "cut out the middleman" the cry is a popular one, but only because it is always some one else who is the middleman.

The middleman is essential. This is grudgingly admitted, but what is not so freely admitted is that it is the middleman who has made cheapened production and increased consumption possible. Of course, we don't want indifferent middlemen who take a toll that they don't deserve. The inefficient middleman will be crowded out by competition.

The central station is essentially a middleman between the coal pile and the light and power. If it did not exist and every big building and factory had its plant and every small building used kerosene, then there might be fewer middlemen between the producers of coal and oil and the consumer of light and power, but the consumer would be less well off than he is now.

The farmer does best when he limits himself to the crops for which his land is suited and does not try to grow other crops which he can obtain better through a middleman. When the shoemaker sticks to his last and does not make his own clothes, when the lawyer does law work and not typewriting, when the factory makes its regular output and does not try to make its own electric light or power, when the railroad superintendent does railroading and does not try to run hotels or mine coal, when the furniture maker buys his wood and does not try to grow a forest, then each one of them will be working most efficiently.

We want more middlemen, and to get them we should encourage and pay them and should not curse them out. It would be a sad day for civilization if the middlemen were abolished.

UNDERESTIMATING COSTS OF MAKING LINE EXTENSIONS

Wrong Estimates Can Be Prevented by Careful Survey of Local Conditions and Application of Correct Data

BY A. G. DRURY

During the past few years the author has had the opportunity to see a large number of estimates on the cost of line extensions to reach prospective consumers. Now, when the ordinary domestic consumer applies for service the company desires to know the cost to it to serve that consumer, hence the estimate. Many companies simply follow an average set of figures for these estimates. For instance, say $15 for each pole set equipped and $5 to $7 for each two-wire span, depending on the price of copper at that particular time.

This may be very well in certain sections of the country where the character of the ground is homogeneous, or where no distinction is necessary because of paved streets and sidewalks; but there are other places where the results from such practice will be far from satisfactory. Of course, the company may protect itself against contingencies by making the estimates liberal enough, where a charge is made to the consumer covering the cost of the extension; but there one runs the risk of losing the customer on account of the price, resulting in a loss to both parties, or in overcharging for the work done, neither of which is desirable. Of course, in the latter instance the argument may be advanced that when an overcharge is made the excess can be refunded. Even granting this,

such practice is not conducive to instilling confidence in a customer.

There have been instances where the consumer was delighted enough at the time he received back part of his advance payment, only to suspect afterward that the company "split the difference" with him, instead of refunding all of the overcharge. Later he has also wondered if the meter was no more accurate than the estimates of extension costs.

On the other hand, it sometimes happens that the company gets very much the worst of the proposition. One case in particular started the writer's investigation along this line. An estimate was made of the cost of a three-pole extension. The work was put through, but when the cost was totaled it was found to be considerably more than double that which was expected.

A considerable number of overestimates were examined with the following results:

The unit cost of wire and pole equipped was correct in every case. The amount of wire needed was satisfactorily computed, being about equal to the ground measurement of the extension plus 10 per cent. This extra allowance was made to account for the sag, tie wires, splices, etc. The amount of equipment on the poles was satisfactorily tabulated. As to the poles themselves, two mistakes were made. The first was in the number of poles. In one case the estimator tried to economize by lengthening the span, or by placing the pole from which the house service was run too far from the house to be connected. Now, the average person is not as a rule enthusiastic about having wires strung across his front yard, and wires are considered especially objectionable when they are for the benefit of a neighbor and not himself. In this instance, a week or so after the service had been strung and the house connected, an additional pole had to be set, which was properly charged against the job. As a rule, therefore, it is best to figure on setting a pole directly in front of the house to be served.

The second common mistake is made in figuring the length of pole. It was found in a few cases that after 35-ft. (10-m.) poles had been hauled to the job they were not tall enough for the lines to clear a very thick tree foliage.

The labor of placing equipment on the poles and stringing the wire was uniform enough in all cases to make fairly accurate the estimate of its cost.

The main cause of inaccuracy in the estimates was mistakes in estimating the labor of setting the poles, most of which is, of course, the labor of digging the pole holes. Every one knows that it takes longer to dig through hard ground than soft, and the following table, made up of the averages of the time required to dig holes 4.5 ft. (1.5 m.) deep in earths of different character, is offered as an aid in estimating this kind of work:

Kind of Soil	Time in Hours
Sandy or loose soil	2.0
Packed soil	2.5
25 per cent small rocks	3.0
50 per cent small rocks	4.0

In an extreme case, involving digging in ground that consisted of about 90 per cent of sedimentary limestone in slabs 3 in. (8 cm.) to 5 in. (13 cm.) thick, separated by layers of sharp sand, two men required two days to dig each hole; that is, thirty-two hours of labor were consumed.

RATE SCHEDULE ADJUSTMENTS SHOULD NOT CAUSE FRICTION

Committee of Public Utility Commissioners Says It Is Normal and Inevitable that Rates Should Increase with Other Costs

The committee on public utility rates, reporting to the National Association of Railway Commissioners at the recent annual convention in Indianapolis, discussed emergency and electric rates. T. W. D. Worthen of New Hampshire is chairman of the committee.

"There has been a feeling on the part of some utilities that they should share in the prevalent high prices and profits," the report says, "but commissions generally feel that frequent and extreme changes in rates are not desirable, but that a distribution of the extra burden over a longer period is to be preferred. It would seem to be desirable to have some prices on a moderate scale, but in attempting to avoid high prices great care must be taken by commissions lest prices be kept so low as to cripple the utilities and prevent the greatest efficiency in service.

"There has been little general progress in improving the types of rate schedules in use. The increase of utility rates in itself occasions friction or dissatisfaction, although it would seem to be natural and inevitable that utility rates should be increased when all other prices are increased, and it has not generally been deemed wise to change the form of rate schedule, which in itself is likely to occasion some friction and thus risk an undesirable combination. It seems a logical procedure when more revenue is needed to adjust the burden as equitably as possible in the first instance so that it shall be properly shared instead of making a percentage or arbitrary flat increase, thus increasing existing inequalities and discriminations.

"Students of rates generally agree that some form of demand or service charge with a meter system is the fairest type of schedule, but in many communities a considerable number of people object to paying a service charge and feel that it is right and proper to have a meter installed on their premises for their exclusive use, and other investment and expenses incurred in care and reading of meters, etc., and to make no payment whatever except when the meter is in active use. The comparison is made between the scales of the grocer and the meter of the utility, and they are classed together, notwithstanding the fact that the grocer does not furnish scales for the exclusive use of each customer. . . .

"The Oregon commission has for some time used a rate schedule which it designates as the 'Oregon form,' of which it says: 'This form is of especial advantage to a commission because of its great flexibility in the substitution of a single rate in lieu of several existing rates. It is a combination block Wright demand and block-meter rate expressed in a relatively simple manner. The unit charges involving the demand feature in the primary rate are reduced for increasing demands, and there is a corresponding reduction for increasing quantities in the secondary rate. The consumer having a very poor load factor pays a high rate for his demand, but only for the time it is in use. For most utilities a single lighting and a single power rate are sufficient. If energy for cooking is to be supplied through the same meter as residential lighting, a different and lower secondary rate for this combined service than for commercial lighting is needed.' "

DIGEST OF ELECTRICAL LITERATURE

Including Brief Abstracts of and References to Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Improvements in the Starting and Controlling of Rotary Converters.—The starting of a rotary converter by means of an auxiliary starting motor and synchronizing through reactance are described in this article. It is also shown how a balancing transformer may be used to insure the proper load distribution between two synchronous converters. This is said to approach standard practice in England.—London *Electrician,* Oct. 31, 1919.

Transformers and Connections to Electric Furnaces.—J. F. PETERS.—The writer considers principally the distribution of the current in large rectangular copper cross-sections when very high currents are required for electric furnace work. It is pointed out that in one case which was investigated the current distribution in a ¼-in. by 12-in. (0.64-cm. by 31-cm.) busbar at 60 cycles frequency resulted in a current one and three-quarters times normal density at the edge, while in the center the density was approximately one-half normal. Both the mechanical strength and the heating must be considered.—*Electric Journal,* September 1919.

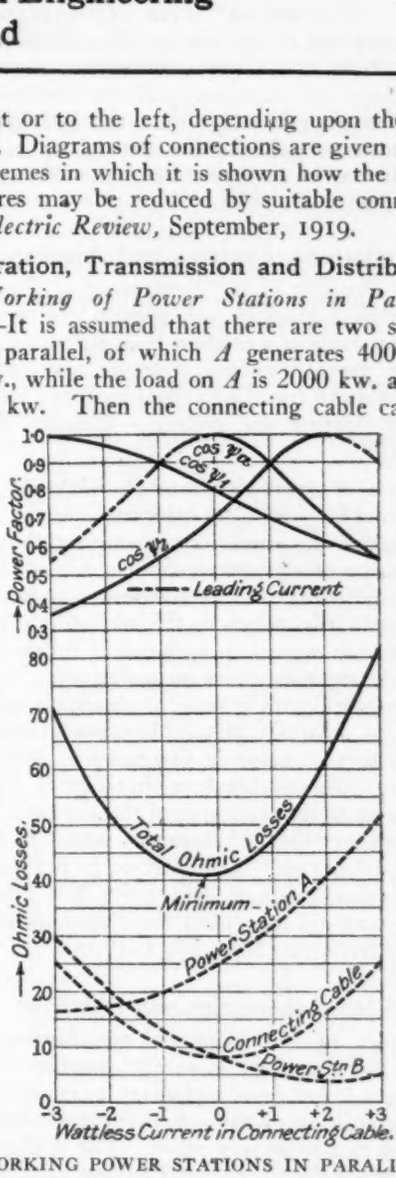
Lamps and Lighting

New Neon Discharge Lamp.—FRITZ SCHROTER.—The lamp is made in several sizes for from 1 watt to 5 watts at 220 volts and gives about 0.1 cp. per watt. It is about 2 in. (5 cm.) in diameter and is fitted with the ordinary Edison screw socket. The bulb is evacuated to a pressure of about 10 mm. and contains a mixture of neon and helium, with traces of mercury vapor to make the light more purely white. A hemispherical shell of thin sheet iron constitutes the cathode. The anode is a wire, bent so close (⅛ in.—3.2 mm.) to the edge of the cathode that luminous discharges start automatically at 220 volts and instantly cover the entire surface of the cathode. A neon lamp for alternating-current supply has both electrodes made of iron wire. The lamp recommends itself for signaling purposes and as a pilot lamp.—*Elektrotechnische Zeitschrift,* April 24, 1919.

Distant Electrical Controls for Military Searchlamps.—THEODORE HALL.—It has been found by experience that an observer operating a military searchlamp finds it difficult to train the searchlamp on the target when he is stationed close to the searchlamp itself. The reason for this is that the observer at the lamp is handicapped by the dazzling effect of the bright beams on the eye. On account of this remote-control schemes have been devised whereby the observer is stationed at a distance of some 500 ft. (150 m.) from the searchlamp itself and there trains the lamp upon the target by means of electrical control. The author describes a number of schemes, known as potentiometer schemes, in which the field of the operating motor is placed across a certain portion of the rheostat and by means of a dial switch the armature may be connected between the center point of the rheostat and points either to the right or to the left, depending upon the direction of rotation. Diagrams of connections are given for various control schemes in which it is shown how the number of control wires may be reduced by suitable connections.—*General Electric Review,* September, 1919.

Generation, Transmission and Distribution

The Working of Power Stations in Parallel.—G. BRECHT.—It is assumed that there are two stations operating in parallel, of which *A* generates 4000 kw. and *B* 2000 kw., while the load on *A* is 2000 kw. and that on *B* is 4000 kw. Then the connecting cable carries 2000



WORKING POWER STATIONS IN PARALLEL

kw. Let the power factor in the network of *A* be 0.554 and in *B* 0.894. Nothing is fixed about the power factor in the connecting cable, which depends upon the excitation in the two stations. When two stations work in parallel under contract it is usual to determine the wattless current and to make agreements with respect to it beforehand. The question, however, arises as to the power factor which can be taken as a datum line. In practical work the questions of general efficiency are apt to give way to convenience of operation. It has been suggested that it should be taken as the average power factor of the network to which the power is supplied, but the author reaches the conclusion that this is wrong. He suggests that the wattless output is to be divided between the two stations so as to reduce the total losses in the two stations

and in the connecting cable to a minimum. The curves show the results of this analysis. The minimum ohmic losses are 40.75. The power factor in station *A* is 0.824, in station *B* 0.664 and in the connecting cable 0.992, with a leading current.—London *Electrician,* Oct. 24, 1919.

Practical Transmission Line Computation. — B. GUERSCHINOVITCH. — By taking into consideration the various cost items of a distribution system the author arrives at formulas for the economical line dimensions which are of a more general nature than the Kelvin rule. By referring to abacas published by the author in 1917, the computations may be greatly simplified.—*Revue Generale d'Electricite,* Sept. 27, 1919.

Installations, Systems and Appliances

Electrical Practice in the Equipment of Blast-Furnace Plant.—J. PERCY HODGES.—A general description of the electrical equipment of a modern blast-furnace plant. This includes the use of capstans, transfer and telpher cars, hoists and overhead traveling cranes equipped with electromagnets for clearing the pigbeds.—London *Electrician,* Sept. 26, 1919.

Interruption of Arcs in Oil and Possibility of Standardizing Oil Breakers.—P. CHARPENTIER.—After discussing in general terms the conditions governing the formation and interruption of alternating-current arcs under oil, the author, in questioning the effectiveness of present German and Swiss standards, refers to the exceedingly scanty material available in regard to high-power breaker tests and urges French engineers and manufacturers to organize systematic research with a view to obtaining reliable data preliminary to adequate standardization of oil breakers. A statistical survey, made in Germany in 1914, is cited, where among 1091 oil breakers investigated 83 per cent did not come up to the standards of the Verband Deutscher Elektrotechniker. Of 705 breakers which had not seen any accident 64 per cent were inferior to the requirements of German rules, while of 386 which had broken down only 59 per cent did not fulfill the requirements.—*Revue Generale d'Electricite,* Sept. 27, 1919.

Electrochemistry and Batteries

The Theory of the Lead Storage Battery. — PAUL BARY.—In discussing the different theories of the lead storage battery it has been customary to consider only the chemical composition of the electrodes, the electrolyte being relegated to a secondary place. The author, who has previously shown the important function filled by the sulphate of lead dissolved in the electrolyte, in this article establishes the new theory of the storage battery which is based upon the electrolysis of this element. — *Revue Generale d'Electricite,* Aug. 16, 1919.

Some Features of the Nisqually Substation at Tacoma, Wash.—This is a 24,000-kw. substation receiving 60-cycle energy at 50,000 volts and distributing through a 4000-2300 volt Y-connected primary distribution system for light and power in Tacoma. One interesting feature is the connection of the standby storage battery for the operation of remote-controlled circuit breakers, meters, pilot lamps, etc. The voltage of the battery is too high for certain of the meters and resistance was formerly inserted in the circuit. Later, however, counter cells were built up from old batteries. These cells reduce the voltage, but at the same time permit a sufficient flow of current to operate the circuit breakers.—*Electrical Review,* Nov. 8, 1919.

Telegraphy, Telephony and Signals

Musical Sparks in Wireless Telegraphy.—T. MINOHARA.—It is a known experimental fact that in order to obtain a pure musical spark in transmitters for wireless telegraphy it is necessary that the frequency of the current furnished by the alternator be dissonant with that of the low-frequency current in such a sense that the said current lags in comparison with the emf. The dissonance must, however, be as small as possible in order well to utilize the power of the alternator. In the present article the author gives the analytical explanation of the experimental results just alluded to. The analytical conditions defining a good musical spark are first given and then substituted in the known equations of the instantaneous values of current intensity and potential difference. The results of the calculations effectively show that a strong, pure, musical note is obtained when the alternator current is lagging; in the resonance conditions the musical note is weak; when the alternator current is leading the sparks give a disagreeable note. The formula giving the power shows, moreover, that the dissonance between the alternator current and the low-frequency circuit must be small, in order to obtain the largest output from the alternator. Tables and curves are given.—*Science Abstracts, Section B,* July 31, 1919. (Abstracted from *Rev. Gen. d'Elec.,* May 24, 1919.)

High-Pressure Discharge Apparatus for Wireless Telegraphy.—W. H. WILSON.—The arrangement described is such that the primary circuit is interrupted when the charging current (oscillatory in character) through the supply source is at or near zero value, and hence there is little sparking at "break." A gradual building up of charge takes place on the condenser, and this resonating effect goes on until a discharge begins to pass at the terminals of the secondary of the spark coil or until the increasing losses in the system bring about a condition of equilibrium. The spark coil 1, 2 behaves like a transformer; in fact, a closed-core transformer can be used in its place. Curves are given showing the currents in the various parts of the apparatus. For wireless transmitting purposes, the secondary of the spark coil is joined in the usual way to the high-pressure condenser of the high-frequency oscillating circuit. Sets can be made for any power input, within reasonable limits that may be required, and for any supply pressure up to 500 volts. Any spark frequency from 100 to 1000 per second can be obtained. Standard sets operate at 650 sparks per second, and many of these have been used during the war under arduous conditions. It is claimed that the efficiency is exceedingly high and may, under suitable conditions, exceed 75 per cent.—*Science Abstracts, Section B,* July 31, 1919. (Abstracted from *Electrical Review,* May 23, 1919.)

Miscellaneous

Critical Speeds of Machinery Placed on Upper Floors of Buildings, as Related to Vibration.—A. B. EASON.—A mathematical investigation of methods of mounting machinery in such a way as to prevent the resonance of vibration with the structure of the building.—*Philosophical Magazine,* September, 1919.

NEWS OF THE INDUSTRY

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields

This issue of the ELECTRICAL WORLD *is the ninth that has been published at Buffalo, N. Y., owing to the troubles in the printing trades at New York City, now over, as announced previously. Publication in New York will be resumed with the next issue, Jan. 3, 1920.*

Summarized News

Principal Happenings Up to Closing of Forms for This Issue— Printed Dec. 31

Sales in the New York territory held up well during Christmas week. Jobbers' stocks of appliances are so broken as to be of little account as such. Christmas-tree lighting sockets are virtually exhausted except for some very late deliveries. Air heaters are moving well and stocks are being kept replenished from factory shipments.

Steel-strip production is still below normal because of certain mill shutdowns, so that the flexible-armored-conductor output is somewhat lower than usual. Enough is available, however, for the work in hand to-day. Rubber-covered wire manufacturers are changing discounts because of scarcity of long-fiber cotton and its increasing price.

Price advances have appeared on iron and wood box bells and buzzers, fir cross-arms and safety switches. Sales of renewable fuses have increased following their recent listing as standard by the Underwriters' Laboratories.

Newspaper dispatches from Paris say that the French Cabinet has approved as a fuel conservation measure the bill providing for turning the clocks ahead one hour, beginning on Feb. 1, 1920.

The Potomac Electric Power Company, Washington, D. C., has protested to the Public Utilities Commission against a proposed set of rules governing the amounts to be paid by consumers for service extensions. The position of the company is that the rules proposed would require untold expenditures without a sufficient guarantee that customers would use enough energy to allow a fair return on the investment.

Employees of the Southern California Edison Company have bought practically all of the 4702 shares of stock set aside for this purpose with the authority of the Railroad Commission. By request of the company, the commission has granted authority to set aside 2500 more shares to be offered in the same way. The stock is to be sold at not less than 90.

The Society for Electrical Development has issued a sixteen-page multigraphed prospectus containing facts and figures based upon the results of a survey covering 446 industrial consumers in fifty-seven towns in fifteen states, in which a large percentage of the industrial activity of the country is concentrated.

Considerable success is reported by the electrical committee which is raising a special fund in honor of Marconi in connection with the general work of the Italian War Relief Fund of America. The electrical committee consists of T. C. Martin, chairman; Dr. Elihu Thomson and J. W. Lieb. Its address is 29 West Thirty-ninth Street, New York.

The electrical industry is asked to give thought to the opportunity to obtain information on foreign trade offered by the seventh national foreign trade convention, to be held in San Francisco on May 12 to 15, 1920.

The Edison medal committee has reported to directors of the American Institute of Electrical Engineers that it has awarded the Edison medal for 1919 to W. L. R. Emmet "for inventions and developments of electrical apparatus and prime movers." The formal presentation of the medal to Mr. Emmet will be made at a convenient later date. Mr. Emmet is known internationally for his historic part in the development of electric propulsion for ships. He is consulting engineer of the General Electric Company.

On account of the continued rise in operating expense the Utah Power & Light Company has applied to the Utah Public Utilities Commission for authority to increase its rates for power, but not for lighting or cooking.

A policy has been taken out by the General Electric Company with the Metropolitan Life Insurance Company to insure the lives of 70,000 employees. It applies to those employed for one year or more. The company pays the expense of the insurance, which will give to the heirs of beneficiaries at death amounts ranging from $500 to $1,500, according to the length of service.

Under the direction of its division on co-ordinate advertising and sales campaigns the Commercial Section of the National Electric Light Association is about to put into effect the plan submitted at the last convention. Monthly reminders will be sent by the section calling attention to the merchandising schedule, under which it is expected drives will be made on certain classes of appliances each month in the year. A lighting schedule is also part of the plan.

There is an acute shortage of power in Ontario, and the Hydro-Electric Commission of that province is asking the co-operation of all who use electricity from Niagara Falls in a policy of conservation until a further supply can be obtained. Danger exists that some of the power now exported to Buffalo from the Canadian side may be commandeered, and there is a movement in that city to claim for its industries the 4400 cubic-second-feet which, under the existing treaty, may still be diverted from the Falls for use in New York State.

A preliminary statement has been issued by the industrial conference created by President Wilson, which has been meeting at Washington. It outlines a national industrial tribunal and twelve regional boards of inquiry. Public criticisms of the plan are invited and will be considered when the conference reconvenes on Jan. 12. The report recognizes that the proposed plan presents greater difficulties in regard to utilities than in competitive industry. Continuous operation of utilities is declared vital to public welfare. The conference considers that there must be some merging of responsibility in public tribunals for regulation of rates and service and settlement of wages.

Employees of the General Electric Company are offered an opportunity to subscribe through long-term payments to what will be known as employee 6 per cent debenture bonds of the company and to United States government 4¾ per cent Victory notes. A special issue of fifteen-year debenture bonds has been authorized, dated Sept. 1, 1919. Bonds and notes will be offered in denominations of $50, $100, $500 and $1,000. Employees of one year or more may subscribe for not exceeding $1,000.

Among the larger projects contemplated throughout the country are: The construction of two hydroelectric plants, one of 6000 hp. and one of 12,750 hp., at Westpoint, Cal., by the Mokelumne River Power Company of San Mateo, Cal. The proposed work also includes two diversion canals, 4½ and 5½ miles long, and dams and reservoirs in the south, middle and north forks of Mokelumne River. The cost is estimated at about $1,288,500.

Plans are being prepared by the Ohio River Power Company of East Liverpool, Ohio, for improvements to its system, including the erection of a transformer house, to cost about $600,000.

The Montgomery (Ala.) Light & Water Power Company is planning to rebuild the dam at its hydroelectric plant, recently destroyed by flood. The cost is estimated at about $1,000,000.

BUSINESS BEFORE N. E. L. A. EXECUTIVE COMMITTEE

Progress in the Work of the National Association Is Reported by the Chairmen of Sections and Officials at Headquarters

Much business pertaining to the general affairs of the National Electric Light Association was transacted at the meeting of the executive committee at headquarters in New York on Dec. 4, a report of which has just been made available. Vice-president Martin J. Insull presided.

Walter Neumuller, chairman membership committee, reported that its program is under way, with several campaigns well advanced. The committee expects early in the new year gratifying results from its efforts.

Frank A. Birch, chairman company sections committee, outlined the work accomplished by his committee. The committee recommends that a bureau be established at headquarters for the supervision of company erection work. A sub-committee of the executive committee will study the report of Mr. Birch and report at a later meeting.

Vice-president M. R. Bump reported on the situation as to geographic sections. A letter has been sent to all member companies in the districts not already organized calling attention to the tentative division of the country and asking for suggestions and support. The committee hopes to receive many suggestions and plans to send out another general letter.

M. H. Aylesworth, executive assistant to the president, reported on the rearrangement of offices at headquarters and also on his attendance at the convention of the National Association of Railway and Utility Commissioners in Indianapolis on Oct. 14. He also told what was being done to relieve the shortage of coal during the strike, which was then in progress.

Mr. Aylesworth spoke of the letter which he sent recently to the executives of Class A member companies, outlining part of the program for future activities of the association and asking for suggestions as to how the work could be improved. Hundreds of answers to this letter have been received and they show careful thought. He also urged that greater interest be taken by the executives of member companies in the company section work.

Reports of Section Chairmen

Chairman Symes of the Accounting Section reported that a well-attended meeting of the executive committee of that section was held in Detroit on Oct. 20. The Accounting Section committee is ready to confer at any time with the committee from the National Association of Railway and Utility Commissioners on the subject of a uniform classification of accounts.

Secretary Marshall of the Electric Vehicle Section reported on its work as Chairman Foster was not present.

For the Technical Section, Chairman Moultrop reported that the work is going along smoothly and energetically. Four representatives from the Pacific Coast were present at a recent meeting of the executive committee of the section and better co-operation between the East and the West will result.

Chairman Learned of the Commercial Section reported that, following the successful series of meetings in October in Chicago, about ten or twelve meetings are planned to be held in New York on Jan. 5, 6 and 7. This method of grouping meetings will make for efficiency and minimize traveling expenses.

The committee indorsed the movement for formation of a National Department of Public Works.

A. I. E. E. CONSIDERS AUTOMATIC TELEPHONY AND SEARCHLAMPS

Increasing Labor Costs Accelerate Progress—Navy and Army Searchlamps Also a Topic at Institute Meeting

Great interest was shown in the analysis of the present status of automatic telephone equipment, as set forth by Arthur Bessey Smith, electrical engineer of the Automatic Electric Company, in a paper delivered Dec. 12 before the A. I. E. E. in New York City. The paper on "The Searchlight in the United States Navy" by Ralph Kelly, formerly lieutenant U. S. N., R. F., was also well received, and Capt. Chester Lichtenberg, U. S. A., brought slides from Washington depicting developments in army searchlamps. President Townley occupied the chair.

Mr. Smith called attention first to the present tendency toward the introduction of automatic devices of all kinds, and he stated that the need for the substitution of automatic for manual operation was particularly acute at this time on account of the shortage of operators and the high cost of labor in general. Mr. Smith presented a very complete statement of the state of automatic exchange development, from the scattered rural communities to the densely populated cities. He presented an optimistic view of the increased traffic on telephone lines which could be handled by automatic operation.

NEW YORK ELECTRICAL CREDIT ASSOCIATION MEETS

After Officers Were Elected, Methods Were Discussed by Which Better Credit Relations Might Be Fostered

About seventy members of the New York Electrical Credit Association met at the Building Trades Club on the evening of Dec. 17 for their annual dinner and business meeting. President Harding reported on the co-operation of the members during the past year in credit matters, and Secretary Neilson reported on the work accomplished by the association and the plans for the coming year. Mr. Neilson reported for Mr. Hochhauser on the work of the bankruptcy committee, and William Green spoke on the membership drive. Mr. Hopper, vice-president of the Chemical National Bank, spoke on credit problems and the necessity for a closer personal relation between the banks and their electrical customers, in order that the banks shall know something about the business problems of their clients. Mr. Chapin of the Federal Reserve Bank spoke on the need for reducing indebtedness and increasing production to raise the standard of the electrical industry.

The newly elected officers of the association are: President, R. E. Edwards, Edwards & Company; vice-president, W. E. Rice; secretary, Franz Neilson; treasurer, A. F. Thacher, Alpha Electric Company.

Mr. Conklin of the Waclark Wire Company spoke on over-credits and failures and submitted a new form for credit information, which was adopted.

W. L. Goodwin addressed the meeting on "How a Credit Manager May Win a Promotion." He touched on the improvement in credits of contractors and dealers and spoke of their constantly increasing requests for greater credits. Mr. Goodwin made four points concerning the establishment of better credit relations in the electrical trade. In the first place he urged credit managers to provide credit facilities so that their customers can buy merchandise, particularly household appliances, on the part-payment plan. Financial institutions, strictly third parties, now provide that service nationally, at a good profit, but the electrical trade was urged to adopt the practice recommended and deal through the local banks. Then credit managers were urged to get acquainted with their customers, learn their business problems, ask permission to look over their books when trouble was apparent and help them over their difficulties. In addition, Mr. Goodwin held, it is necessary for credit managers to become better acquainted with competitors. The classification of customers was advocated, in order to learn the amount of credit risk taken on the different classes of the electrical trade. Finally, the importance of getting the electrical trade into its own credit associations was shown, and in this connection Mr. Goodwin launched the membership drive of the local association. The initial endeavor is to add 150 new members by April 1, and various members volunteered to add personally new members to a total well in excess of the goal.

BUREAU OF STANDARDS HOLDS SAFETY CONFERENCE

Recent Reorganization of the American Engineering Standards Committee Is Reviewed and Methods and Policies Discussed

An industrial safety conference was held at the Bureau of Standards, Washington, on Dec. 8. In the absence from Washington of the director of the bureau, Dr. S. W. Stratton, the meeting was called to order by Dr. E. B. Rosa, who summarized the events leading up to this conference and referred especially to the proceedings of the similar conference on Jan. 15, 1919, of which this in a sense was an adjourned meeting.

Dr. Rosa also announced the appointment of a general advisory committee on industrial safety codes for the purpose of assisting the Bureau of Standards in deciding upon policies and procedure in its work on safety codes. He said: "The advisory committee recently appointed by the bureau is not the managing committee proposed under plan A. It is for the present merely an advisory committee for the Bureau of Standards. After this conference is ended that committee will meet and deliberate. If this conference wishes to make any recommendation on request to that committee, it can do so, or if it wishes to adopt it as a committee of this conference, it can do so. This conference can have a different committee if it prefers, or it can appoint some additional members to sit with or become part of the bureau's committee. We want this conference to feel entirely free to discuss the important question submitted without hindrance or restriction of any kind."

Prof. Comfort A. Adams, chairman of the American Engineering Standards Committee, then spoke on the work of that committee and of its recent reorganization with membership from such organizations of national scope as may be approved. There shall be no more than three members from each such organization, Dr. Adams explained, and the annual dues are placed at $500 for each representative. Applications for membership must set forth the scope of their standardization interests and activities and the number of members. If such application is approved by three-fourths of the committee, it is submitted to the organizations having membership on the committee and unless disapproved by more than one-fourth of these within ninety days it is considered to be ratified.

The speaker stated that he would be superseded as chairman of the committee by A. A. Stevenson, and that the permanent secretary of the committee will be Dr. P. G. Agnew, at present in the Bureau of Standards. The headquarters of the committee will be in New York City.

The procedure to be followed in the development and adoption of American engineering standards was then outlined. Committees to formulate standards shall be organized by suitable engineering societies, government bureaus or other bodies which shall be designated as sponsors and shall be responsible for the carrying out of the work. Such committees must include representatives of all interests concerned in the formulation of a standard, and upon completion of its work and substantial agreement upon the same it shall report to the sponsor body. If the latter adopts the standard, it is forwarded to the American Engineering Standards Committee for approval, and when so approved shall be designated as either recommended practice, tentative standard or American standard. The standards committee will not itself pass judgment upon the details of the proposed standards, but rather upon the composition of the committee which has formulated the standard or approved it. The committee must not be confined to the membership of the sponsor body, but must include representatives of all interests concerned in the standard.

A number of organizations have already applied to the American Engineering Standards Committee for membership. These include the National Safety Council, American Mining Congress, insurance, utility and technical associations. To become a member an organization must be national in its scope. Thus individual state industrial commissions would not be considered eligible, but as a group they might join through their national association.

The status of industrial safety codes now existing was next discussed by Dr. M. G. Lloyd, Bureau of Standards; Dr. L. W. Chaney, Bureau of Labor Statistics; S. D. Collette, American Society of Mechanical Engineers, and W. S. Paine, Aetna Life Insurance Company.

A symposium on methods and policies to be pursued in the development and introduction into use of safety standards was participated in by S. J. Williams, National Safety Council; O. B. Connelley of the Department of Labor and Industry of Pennsylvania; C. M. Talbert, Department of Streets and Sewers, St. Louis; W. C. L. Eglin, National Electric Light Association; A. C. Morrison, International Acetylene Association; A. Rousseau, Abrasive Wheel Manufacturers' Association; Henry Sterling, American Federation of Labor, and Lew R. Palmer, Equitable Life Insurance Company.

Chester C. Rausch of the Safety Institute of America

introduced the following resolution, which was adopted by the conference:

"Resolved, That the American Engineering Standards Committee be asked to request the International Association of Industrial Accident Boards and Commissions, the Bureau of Standards and the National Safety Council to organize a joint committee on safety codes, this committee to include representatives of these bodies and such others as they may consider advisable; that this joint committee report upon the safety codes required, priority of consideration of the codes, and sponsor bodies for their preparation; that this report be put in writing and placed not later than Feb. 1, 1920, in the hands of the American Engineering Standards Committee."

At a meeting of the general advisory committee of the bureau on the following day the work of the proposed committee which the American Engineering Standards Committee has been asked to appoint was further discussed, and the opinion was generally expressed that such a committee, if made a permanent organization, would render the general advisory committee of the Bureau of Standards unnecessary. There was also a discussion of means for introducing codes and for securing interpretations of rules in particular cases as the necessity might arise.

Before adjournment a motion was passed giving the Bureau of Standards a vote of thanks for taking the lead in calling these conferences and bringing the matter of engineering and safety standards to the attention of all concerned.

GEOLOGICAL SURVEY PLANS FOR THE STUDY OF POWER

Dr. G. O. Smith Discusses Importance of Interstate Investigation of Power Resources and Conservation by Interconnection

Dr. George Otis Smith, director of the United States Geological Survey, discusses in his annual report to the Secretary of the Interior the importance of a nation-wide program of power conservation and utilization of water-power resources.

"Under the war demand for fuel conservation," he says, "the hydraulic engineers of the Geological Survey served the Fuel Administration in a field study of power problems. The co-operative contribution was both statistical and engineering, and its results showed the fuel requirements of the electrical utilities of the country and indicated where a surplus of power was available, where inadequate power supply could be remedied, and where fuel economies were possible either through interconnection with more efficient plants or substitution of water power for steam. Thus a power survey of the United States was begun, and with the termination of this co-operation with the Fuel Administration at the end of the war the Secretary of the Interior asked of Congress two appropriations, one of $50,000, for continuing this power survey over the whole United States, and the other of $200,000, for an intensive survey of the industrial zone of the East, where power requirements are most congested.

"It appropriately comes within the province of the Geological Survey to plan this power investigation, both because this is the original federal agency in making the earlier irrigation surveys and because for the last twenty-five years the Geological Survey has been given annual authorization for 'determining the water supply of the United States' and for reporting 'upon the best methods of utilizing the water resources.' At present in the central power plants of the country water power carries only about 40 per cent of the load, while the total fuel requirement for steam-generated power, including that of the railroads, is not less than 800,000 tons daily. A power program that calls for the immediate and full development of every available and feasible water power, moreover, means saving both in coal and in man power, and with this purpose of securing the double conservation the investigation has been proposed. The first step is to get the facts for the country as a whole, and particularly for the North Atlantic industrial district.

"This 'super-power' project, which engineers agree seems wholly practicable but which can be regarded as now only in the vision stage, is to pool the power supply for the whole industrial area between Boston and Washington, in which is concentrated one-fourth of the power-generating capacity of the country. Such a unified power system would tie together properly located steam-electric and hydroelectric plants—old plants that are efficient as well as new plants—in a great power main from which would flow the energy to serve a score of railroads, hundreds of public-service companies, thousands of mills and factories, and millions of homes.

"The subject is necessarily one for interstate investigation and is linked with the national problem of providing adequate transportation facilities. Electrification of our railroads would effect fuel economies of more than 50 per cent in coal consumed, not to mention the greater efficiency of electric traction through increasing road capacity. Equally important, moreover, is the relation of cheaper power to American industry."

SPAIN IS TO HAVE AN ELECTRICAL EXPOSITION

Permanent Building to Be Erected at Barcelona and Display of Electrical Machinery Planned for First Show

Spain is planning for an important international electrical exposition, according to a report to the Bureau of Foreign and Domestic Commerce from P. S. Smith, one of its trade commissioners. Permanent buildings are being erected at Barcelona and will be completed late in 1920. Manufacturers of machinery are to be invited to furnish exhibits which will fall in one or more of the following twelve groups:

Group 1—Generation, transformation and accumulation of energy. Group 2—Transmission and distribution of energy. Group 3—Apparatus and methods of investigation, demonstration and measurement. Group 4—Electric lighting; electricity in the home. Group 5—Application of electricity to the manufacturing industry. Group 6—Application of electricity to traction. Group 7—Telegraphy, telephony and radio-telegraphy. Group 8—Application of electricity to medicine and hygiene. Group 9—Electrochemistry and electrometallurgy. Group 10—Electricity as applied to agriculture. Group 11—Application of electricity to the exploitation of the subsoil. Group 12—Technical application of electricity.

RESOLUTIONS OF I. E. S. ON THE DEATH OF W. D. WEAVER

Council of the Illuminating Engineering Society Expresses Sorrow at the Loss of Former Editor of "Electrical World"

Resolutions expressing sorrow at the recent death of William D. Weaver, former editor of the ELECTRICAL WORLD, have been adopted by the council of the Illuminating Engineering Society. They were prepared by a committee consisting of Dr. A. S. McAllister, chairman, L. B. Marks and C. O. Bond. The resolutions are as follows:

WHEREAS the council of the Illuminating Engineering Society has learned with sorrow of the sudden passing away in sleep during the night of Nov. 1, 1919, of our charter member William Dixon Weaver, whose active interest in our society was maintained without interruption from the date of its foundation to the time of his death; and

WHEREAS he served the society with distinguished loyalty and success as chairman of the committee which drafted the initial constitution and bylaws in 1905, as one of the first directors elected in 1906, as chairman of the first committee on editing and publication, as chairman of the first committee on finance, as chairman of the committee on securing new members in 1907, as chairman of the committee on papers in 1908, as a member of the committee on the I. E. S. lecture course at Johns Hopkins University in 1910 and also at the University of Pennsylvania in 1916, as chairman of the committee on revision of the constitution in 1915, and as a member of the committee on revision of the constitution and bylaws when death overtook him; and

WHEREAS all members of the Illuminating Engineering Society, and especially the members of the council, with a full appreciation of the invaluable aid rendered to the society by Mr. Weaver, desire these facts to be placed on record; therefore be it

RESOLVED, That in the death of Mr. Weaver we have lost a true friend whose untiring interest in the Illuminating Engineering Society, complete sympathy with its objects and labors in its service were ever directed toward the promotion of its welfare and the realization of its highest ideals; and be it further

RESOLVED, That these resolutions be spread upon the minutes of the council and printed in the *Transactions* of the society and that a copy be sent to Mrs. Weaver.

MEETING OF WESTERN ELECTRICAL INSPECTORS

Association to Hold Its Fifteenth Annual Convention at St. Louis on Jan. 27 to 29 and to Discuss Various Topics

Following is the tentative program for the fifteenth annual meeting of the Western Association of Electrical Inspectors, to be held at the Planters' Hotel, St. Louis, on Jan. 27, 28 and 29, 1920:

Tuesday, Jan. 27—Morning Session

Address of welcome, Mayor Henry W. Kiel.

Reply to address of welcome, K. W. Adkins, vice-president, Kansas City, Mo.

President's address, C. K. Cregier.

Address, "The Responsibility of the Public Service Company for Safe Wiring on Consumer's Premises," by Thomas J. Leahy, St. Louis.

Address, "The Use of Incandescent Lamps in Dusty Places," by Chester L. Dows, engineer National Lamp Works of General Electric Company, Cleveland.

"The Introduction of High Voltage Current Into Buildings": (a) "The Underwriter's Viewpoint," by H. J. Woods, engineer Missouri Inspection Bureau, St. Louis; (b) "The Central Station's Viewpoint," by Walter H. Millan, superintendent of substations, Union Electric Light & Power Company, St. Louis.

Tuesday, Jan. 27—Afternoon Session

Address, "The Elimination of Conflicts Between Fire and Safety National Electrical Codes," by A. Waldschmidt, engineer Bureau of Standards, Washington.

Address, "Analysis of Electrical Fire Causes," by Charles H. Lum, assistant to general manager National Board of Fire Underwriters, New York.

"Regulating the Electrical Appliance Hazard": (a) "The Manufacturer's Duty," by H. T. Mauger, executive department Edison Electric Appliance Company, Chicago; (b) "The Electrical Contractor and Dealer's Duty," by A. C. Brandt, manager electric shop, Frank Adam Electric Company, St. Louis; (c) "The Central Station's Duty" (no acceptance); (d) "The Electrical Inspector's Duty," H. F. Strickland, chief electrical inspector Hydro-Electric Power Commission of Ontario, Toronto.

Wednesday, Jan. 28

Discussion of inspector's problems. Members are asked to present these to the secretary in writing, as far in advance of the meeting as possible.

Thursday, Jan. 29

Address, "Technical Sub-Committee's Work in Revising Motor, Moving-Picture Machine and Garage Wiring Rules," by F. A. Barron, engineer General Electric Company, Schenectady.

Election of officers.

Inspection tours will be made on Friday, Jan. 30.

PROPOSED REVISION OF NIAGARA RIVER TREATY

Plan Offered by Representative MacGregor to Change Diversion Treaty to Permit Use of More Water for Power

There was recently published in the Buffalo *Evening News* a plan by Representative Clarence MacGregor of Buffalo to extend the Niagara River diversion treaty now existing between the United States and Great Britain so as to make it possible to take 60,000 additional cubic-second-feet from that river for power purposes. This would increase the present diversion as allowed by the treaty to 116,000 cubic-second-feet. The proposal is to divide the additional diversion equally between Canada and the United States. That would give Canada 66,000 cubic-second-feet as against the present limit of 36,000 and the United States 60,000 cubic-second-feet as against 20,000.

In commenting on this plan, the *Evening News* says:

"Figuring 30 hp. to the cubic foot of water diverted, we would have from the 50,000 ft. that would be our portion 1,500,000 hp., or about six times the present total development on this side of the Niagara. For the Canadians it would mean 1,980,000 hp., or 480,000 hp. more than could be developed on this side of the stream.

"Forward-looking men have realized from the time that the Niagara electrical venture established itself as a success that additional diversion would be necessary. Niagara has attracted to itself peculiar industries, industries requiring power in abundance in their operations. In late years the demand for power has far exceeded the supply. Men of enterprise, eager for greater ventures, have been forced to mark time. The additional diversion will open the way for them. Canada is eager for an increased diversion. Municipalities without number on the Canadian side are clamoring for additional Niagara power, with which some 200 are now supplied in small measure. Sir Adam Beck, the Ontario power minister, the greatest builder in the Niagara field, will give ready support to Mr. MacGregor's proposal."

MERCHANDISING PROBLEMS DISCUSSED IN SOUTHWEST

Central-Station Officials, Jobbers and Contractor-Dealers Meet to Consider Goodwin Plan of Co-operating

Important meetings of local electrical men have recently been held in Oklahoma City, Okla., and Dallas and Houston, Tex., to discuss the "Goodwin plan" of practical co-operation in the electrical industry and listen to addresses by W. L. Goodwin and C. A. Payne of the General Electric Company, Samuel Adams Chase of the Westinghouse Electric & Manufacturing Company and O. H. Caldwell, editor of *Electrical Merchandising*.

The meeting at Oklahoma City on Dec. 8 was the largest ever held of the local electrical interests of the city. Those held in Dallas and Houston were under the auspices of the local Jovian leagues. Arthur J. Binz of Houston, twentieth Jupiter of the Jovian Order, and Charles A. Newning were guests of honor at the meeting in Houston. A. Hardgrove, who is in charge of the Insull interests in Texas, presided at the Dallas meeting on Dec. 5.

VACUUM-CLEANER ASSOCIATION IS FORMED BY MANUFACTURERS

New Association Will Work for the Betterment of Industry—Charles S. Beardsley of Canton, Ohio, Is Chairman

All the vacuum-cleaner manufacturers in the United States were represented at a meeting in Cleveland on Dec. 5. The Vacuum Cleaner Manufacturers' Association was formed for the betterment of the vacuum cleaner industry.

Officers for the coming year were elected. Charles S. Beardsley, United Electric Company, Canton, Ohio, was unanimously elected chairman. A. J. Stecker, Stecker Electric Company, Detroit, is vice-chairman. C. G. Frantz, Apex Electrical Manufacturing Company, Cleveland, is secretary and treasurer. An executive committee was appointed, consisting of R. S. Hunting, General Electric Company, Fort Wayne, Ind.; H. W. Hoover, Hoover Suction Sweeper Company, North Canton, Ohio, and A. S. Phillips, Spencer Turbine Cleaner Company, Hartford, Conn.

HOWARD McCALL MEMORIAL FIELD IN PHILADELPHIA

Recreation Grounds Named in Honor of Joseph B. McCall's Son and Dedicated in Memory of Employees Who Died for Liberty

The Howard McCall Field of the Philadelphia Electric Company is within a half hour's ride of the business center of Philadelphia and is twenty-six acres in extent. It was dedicated on May 15, 1919, in memory of the fifteen employees who gave their all on the fields of France and was named in honor of Captain Howard C. McCall, the oldest son of Joseph B. McCall, president of the company. Captain McCall was killed in France. In the fall a memorial plaque in honor of the fifteen employees was unveiled at the field by Mr. McCall, the bronze tablet having been placed on an outer wall of the club house.

For a number of years the athletic field was known as Kelly's Lane, after one of the thoroughfares bounding the property, but at the unanimous request of the employees it was renamed in honor of Captain McCall.

The field is under the supervision of the athletic association, and everything there but the restaurant service is free to the employees, all that the average country club offers for from $50 to $100 a year being furnished without a penny's cost.

Included in the equipment are a baseball field, a nine-hole golf course, five clay tennis courts, quoiting grounds, trap shooting, children's playgrounds, employees' gardens, locker houses for both men and women and a dance floor.

The various departments have picnics and outings at the field during the year, and the new playground for children is one of the best equipped recreation plots in the vicinity of Philadelphia. It has enabled the mothers to use the field more than ever, and it has given the youngsters many afternoons of pleasure in the open and away from the dangers of city play.

GENERAL VIEW OF THE HOWARD MCCALL FIELD, SHOWING PLAYGROUND AND GOLF COURSE AND CLUB HOUSE

REGULATION IS SUSTAINED, SAYS CALIFORNIA COMMISSION

It Believes that Further Proof of the Soundness of the Practices of the Commission Will Be Found with Return of Normal Conditions

Declaring that the regulation of public utilities as practiced by the California Railroad Commission during times that threatened public welfare in many ways has been sustained, and that it believes further proof of the soundness of the practices of the commission will be found with the return of normal conditions, the commission in a letter to Governor Stephens reviews its work during the year ended June 30, 1919.

Of the change from war-time conditions to those of peace the commission says in part:

"Cessation of hostilities did not in any appreciable way lessen the burden placed on the commission by war's abnormal demands. The coming of peace, on the contrary, so far as the commission's work was concerned, added new problems and developed new tests of the efficacy of utility regulation. The 'reconstruction period' carried its own peculiar problems, and each was reflected in the work of the utilities. Labor shortage was replaced by labor unrest. Labor and material prices remained at a high level, the situation being aggravated by an uncertainty of movement that affected all utilities and made regulation a matter calling for the keenest attention and most careful application.

"As the commission met the problems developed by the war and the unprecedented situations created by the governmental and private efforts to win the war, and, we believe, maintained for California utilities a soundness that was reflected in a most efficient operation, it met the newer conditions and by a continuation of its broad policy, based on regard for the rights of the public and fairness for the investor and the utility, developed the high standard of service to the ratepayer which practically eliminated the difficulties expected as a natural result of the change from war-time conditions to the ways of peace."

In speaking of the settlement which it brought about of the long-standing controversy between the Southern California Edison Company and the city of Los Angeles, the commission says that it realized that there was a rapid drift toward a situation where either the city of Los Angeles must allow its electric power generated on the aqueduct to go to waste or it would duplicate the existing distributing system of the Southern California company. "The city already had an investment of millions of dollars in its power project and the electrical energy generated on its aqueduct must be put to use. To duplicate the existing distributing system would mean a bitter competitive fight, resulting in serious loss both to the city and the company. It was concluded therefore by the commission that the intelligent procedure would be a purchase of this distributing system by the city."

The commission writes that the predicament of the state's utilities, due to the constantly changing operating conditions, was reflected principally in applications for authority to increase rates. The petitions in every case set up the claim that increased labor costs and higher material prices had destroyed the margin between financial soundness, with ability to function properly, and profitless operation; between efficient service to the public and service hampered by income insufficient to meet constantly increasing demands for service.

"The commission found it necessary," says the letter, "to grant many increases because of the showing made by the utilities, which was carefully checked, and from investigations made by the commission's staff. As a matter of fact, the need for increased income for the utilities to enable them to function to the highest point of efficiency was obvious. We believe that on the whole the commission's rate decisions have been received by the public as necessary acts of fair dealing on the part of the commission, acts fair alike to the consumer and the utility."

Increases ranging from 10 to 20 per cent were granted to twenty-two electric utilities. Most were in the nature of a percentage surcharge upon existing rates, the commission preferring to grant what it considers emergency increases rather than disturb the permanent rate structures of the utilities.

It is stated that "California public utilities, both from an operating and a financial point of view, present an outlook that, we believe, reflects favorably the work of the commission." Pointing out that the utilities are going forward with development and construction work to meet the growing needs of the state, the commission says:

"Hydroelectric companies have started new plants which will entail an expenditure of more than $25,000,000. The construction work is being actively carried on, and some plants will be in operation in 1920 and others in 1921. While an expenditure of $25,000,000 may seem large, we are satisfied that it will not result in an overproduction of hydroelectric energy. It will permit the suspension of the more costly generating of electric energy by steam plants, result in the saving of from 2,000,000 to 2,500,000 barrels of fuel oil and a material reduction in operating costs, all tending toward a development that ultimately will bring to the ratepayer a maximum of service at a minimum of cost, the real aim of utility regulation."

MEETING ABNORMAL DEMANDS

Distribution of electrical energy under the plan devised by the commission as a means of meeting the abnormal demands for power created by the enormous industrial growth of the state, due to war's demands, was continued beyond the war period, the plan having withstood the strain placed upon it and enabled the thirty utilities which joined in the conservation-of-power scheme outlined by the commission to meet every emergency.

"Distinctly a war measure," says the commission, "the pooling of power and its distribution from a central source proved so efficacious that the utilities themselves, though relieved of the actual strain upon their resources produced by excessive industrial demands, determined upon its continuance, the only difference in its operation in peace time as against war time being the elimination of restrictions placed upon unnecessary industries.

"Power administration, as outlined by the commission, practically assures for the state a power situation that can be relied upon for any emergency, its usefulness having been proved by the test of war as well as the ever-recurring shortage following an abnormally dry period. With all the companies in the northern and central part of the state interconnected, as they now are, and the southern companies also interconnected, the danger of power failure in California is reduced to a minimum."

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities.

Line Construction Beyond Chartered Territory.—A decision of the Pennsylvania Public Service Commission affecting the York Haven Water & Power Company holds that under the Pennsylvania act of July 2, 1895, providing that corporations organized for the purpose of supplying water power shall have authority to supply electrical energy and power to any place or places, the commission may approve the construction of a transmission line, although such line is not within the territory for which the company was chartered.

Municipal Contract Made After Declaration of War.—While the Illinois Public Utilities Commission held that it has jurisdiction to alter the terms of a contract entered into between a city and a utility, nevertheless, where it appears that a utility entered into a twenty-year contract with a city, fixing rates, after the formal entry of the United States in the world war, the commission refused to alter those rates, for the reason that the utility entered into the contract with full knowledge of its probable results and cannot complain of the consequences of its agreement. This was the decision in the matter of the petition of the Eastern Illinois Utilities Company relative to electric rates at Effingham.

Responsibility for Continuous Operation.—A decision of the Illinois Public Utilities Commission in the matter of the complaint of the Western Casket Hardware Company et al. vs. the Aurora, Elgin & Chicago Railroad Company regarding electric light and power service in Elgin dealt with the responsibility of the company for continuous operation. Where it appeared that an electric utility, under contract with a city, had failed to provide electrical energy for general lighting and power service for a number of days, resulting in great inconvenience and loss to the city's industries and to hundreds of employees of said industries, and creating an unsafe condition because of the lack of lights, and a hazardous fire condition, because of the necessity of using kerosene and candle lights, the commission ordered that such service be re-established within thirty-six hours, regardless of the fact that the utility's employees were all on a strike for a substantial increase in wages.

"Fair Value" of the Property.—The Public Service Commission of Pennsylvania, acting on the report of the engineering bureau, refused to sustain that part of complaint against the Mercersburg Lehmasters & Markes Electric Company which alleged inadequate facilities and service. The complaint, in so far as it related to the unreasonableness of rates, was sustained. The term "fair value" is relative, depending upon all the facts and circumstances surrounding the rendition of the service, the commission held. When an electric light plant is used only because the owner was able to acquire it at judicial sale at a price far below its reproduction cost in its original form, under such circumstances the purchase price, as fixed by the parties, plus the additions and improvements made since that time, substantially represents the fair value; and especially so when the owner has so carried it upon his books. There should be allowed in the annual operating cost for superintendence of the plant what the requirements of the situation demand, whether such service be rendered by the respondent or another person, and the return to be allowed should be computed on the fair value of the property and paid in addition to proper operating costs, including superintendence.

Fixing Reasonable Rates.—The Missouri Public Service Commission decided, in a case relating to the Portageville Light & Power Company, that though a public utility might be entitled to additional revenue, its rates should not be increased so much as to result in a net loss through curtailed consumption, as where a utility's output is low rates no greater than the value of the service to the consumer, yielding a greater net income through increased consumption, should be established. The commission said in part: "The company is entitled to more revenue beyond a doubt. The problem in this case is to fix rates which will yield more net income and which are not greater than the service is worth to the consumer and which will hold present consumers and attract others. . . . The company should make every effort to increase the demands and number of its consumers. The consumers should understand that increasing the numbers of consumers and the quantity of electricity sold will enable the company to reduce its rates."

Combined Light and Ice Company.—The Public Utilities Commission of Illinois, after considering the condition of the West Salem Light & Ice Company, decided in part as follows: "The commission believes that the electric utility should not be burdened with any of the expenses of the operation of the ice plant, and that if the operation of the ice plant is responsible for the deficit shown, the accounting methods of the company should be revised to such an extent as is necessary to show separately the results of the operation of the electric plant, to the end that it may determine the facts regarding such operation. The commission, of course, cannot forbid the dismantling of the ice machinery in case the petitioner desires to remove the same. It does, however, feel that the operation of the electric plant should be continued as long as it is possible to do so with a reasonable financial return. The law provides means by which the electric utility may secure an adequate financial return in case it is not now doing so. In view of all the circumstances connected with this matter, the commission will not permit the discontinuance of the operation of the electric plant at this time as set forth in the findings hereinafter made."

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies.

Petition Insufficient to Show Right of Action.—Where petition against owner of house supplied with electricity by uninsulated wire, by which plaintiff was injured when he fell in walking along an adjacent woodland lot not owned by defendant, alleged negligence as to sagging and uninsulated condition but did not allege any invitation to use path or that its character amounted to an invitation or permission, or show that injury resulted from its use in exercise of such permission, a general demurrer was properly sustained. (Scott vs. State Mutual Life Insurance Company, 100 S. E. 639.)

Commission Need Not Afford Hearing Before Making New Schedule.—The statutes creating the Railroad Commission of Georgia and giving it power over public service corporations do not require the Railroad Commission to afford a hearing before it in the exercise of its function to make schedules of rates to be applied in the future, and where, in the formation of rates, the Railroad Commission considers a document on file in its office as to the value of the property of a company for which rates are to be prescribed, without formally introducing such document in evidence at a hearing which has been held, the fact that such document is so considered will not be sufficient ground to authorize the courts to set aside as void the order of the Railroad Commission prescribing rates. (City of Atlanta vs. Georgia Railway & Power Company, 100 S. E. 442.)

Regulation of Interstate Electric Service.—The transportation or transmission of electrical energy from state to state through appropriate instrumentalities is "commerce" between the states. The transportation or transmission of electrical energy direct from the seller in one state to the consumer in another, for immediate or practically immediate use, subject only to a temporary stop en route for the purpose of reducing the energy to a commercial voltage, remains "interstate commerce" until the commodity has reached its goal, unless theretofore sold to independent distributing companies in the latter state for resale to local consumers. The regulation of the rates at which electrical energy transported or transmitted from one state to another shall be sold in the latter state is, so long as the rate fixed is not confiscatory or discriminatory against citizens of another state, a matter essentially local in its nature, and not of such national importance as to require a general system and uniformity of regulation. (Mill Creek Coal & Coke Company vs. Public Service Commission, 100 S. E. 557.)

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

FOR TRADE-MARK PROTECTION.—A bill giving effect to the agreement of the United States and the Central and South American states and Cuba for the protection of trademarks has been reported to the House of Representatives by the committee on patents.

IOWA MUNICIPAL PLANT CLOSES.—Voters of Eldon, Iowa, have ratified a contract between the municipality and the Ottumwa Railway & Light Company for the purchase of the community's electric energy requirements from the company. The municipally owned steam plant, which has generated energy for street lighting and business and residential use, will be abandoned. The company is building an extension of its transmission lines to serve the new town.

NEWSPAPER GOOD WILL FOR THE CENTRAL STATION.—The new policy of broadside advertising of the combined electrical industry which has been inaugurated in California through the combined efforts of the publicity committee of the Pacific Coast Section, N. E. L. A., and the California electrical co-operative campaign has already resulted in a responsive interest on the part of the newspapers which is apparent in the news and editorial columns of the papers. An editorial which was printed in a recent issue of the Bakersfield *Californian* was reprinted in leaflet form by the San Joaquin Light & Power Corporation and made available to its customers.

DISTRIBUTION BUILT FOR FUTURE RANGE LOAD.—R. B. Woolley of the Society for Electrical Development, P. L. Miles of the Edison Electric Appliance Company, Chicago, E. I. Williams of the Estate Stove Company, W. M. Arthur of the Northern Ohio Traction & Light Company and K. Fitzpatrick and J. C. Mathieu of the Dayton Power & Light Company were among those who addressed the meeting of the new-business co-operations committee of the Ohio Electric Light Association at Toledo on Nov. 19. A considerable portion of the time was given up to the discussion of electric cooking and methods of making profits on this service. Mr. Arthur stated that his company had plotted a map to show the locations of electric ranges and had found that 75 per cent of them are in the territory served with natural gas at 35 cents per 1000 cu. ft. He said further that whenever the Northern Ohio Traction & Light Company rearranges its distribution lines it installs a new circuit large enough to take care of 50 per cent future saturation of electric ranges.

MUNICIPAL LIGHT PLANTS TO DISCONTINUE.—New Vienna and Lynchburg, Ohio, have decided to abandon the use of their municipal electric light plants. The municipalities will buy service for street lighting and other purposes from the Dayton (Ohio) Power & Light Company, which will also supply service directly to the lighting customers of the municipal plant as soon as the necessary line extensions are completed. The Dayton company purchased the property in one case, while in the other the municipality agreed to shut down its plant and gave the company a franchise. The municipal plants will continue to operate while the company's 14,000-volt lines are being extended from Wilmington, Ohio, about 23 miles, in order to serve the communities. K. Fitzpatrick, Jr., lighting sales agent for the company, reports that every effort is being made to give the old municipal-plant customers central-station service by Christmas. The task is made difficult, however, because three other line extensions aggregatitng about 15 miles are being made simultaneously.

DALLAS COMPANY CONTROLLED BY GENERAL ELECTRIC COMPANY.—Mayor Wozencraft of Dallas, Tex., has received a letter from Owen D. Young, vice-president General Electric Company, showing that that corporation is in virtual control of the Dallas Railway Company. The letter says, in part: "In 1917 the Dallas Electric Company controlled the street-railway properties in Dallas (other than the lines of the Northern Texas Company) through ownership of the outstanding stocks and other securities issued by the three local companies. It was the wish of the city and the purpose of those who became interested in the new franchise that the holding company should be wholly eliminated from the situation, but an outstanding issue of unmatured bonds (due April 1, 1922), secured by deposit of all the securities (together with the stocks and bonds of Dallas Electric Light & Power Company, also then owned by Dallas Electric Company), created a legal and practical business situation such that time was required for accomplishing the desired result. The actual liquidation and dissolution of the Dallas Electric Company may be expected to occur within a reasonable time after the maturity of the bonds, namely, April 1, 1922, and in any event not later than the time for the payment of the purchase money under the Stone & Webster agreement, namely Oct. 8, 1925. The ownership of the Dallas Railway Company is the same as that of Dallas Electric Company, and its owners in reality are, chiefly, the United Electric Security Company of Boston and General Electric Company of New York. The security company is an investment and not an operating company. The General Electric Company itself, though not yet the actual holder or owner of any Dallas Electric Company stock, is a large and influential stockholder in said securities company and is under agreement with the latter to take over a large portion of the stock which the securities company controls (partly by present ownership and partly by contract to purchase) in the Dallas Electric Company. The General Electric Company, therefore, is in virtual control of the Dallas Electric Company."

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

A. A. E., SEATTLE SECTION.—Charles H. Newhall is temporary president and Jesse A. Jackson temporary secretary-treasurer of this newly organized section of the American Association of Engineers.

A. I. E. E., INDIANAPOLIS-LAFAYETTE SECTION.—"Modern Problems of Automatic Telephone Exchanges" was the subject of a talk by B. C. Groh, New York City, who addressed the Nov. 14 meeting of this section of the American Institute of Electrical Engineers.

A. I. AND S. E. E., PHILADELPHIA SECTION.—"Electric Mill Drives" is to be the subject of J. D. Wright, electrical engineer, power and mining division, General Electric Company, Schenectady, N. Y., who will address this section of the Association of Iron and Steel Electrical Engineers at its Jan. 3 meeting.

A. I. E. E., BOSTON SECTION.—Prof. Comfort A. Adams of Harvard University, chairman of the electric welding committee, Emergency Fleet Corporation, United States Shipping Board, will be the speaker at the Jan. 6 meeting held by this section of the American Institute of Electrical Engineers, his subject being "Electric Welding."

DISCUSSION OF CENTRAL-STATION STEAM-HEATING PROBLEMS.—At the meeting of the Portland (Ore.) sections of the American Institute of Electrical Engineers and the National Electric Light Association on Tuesday, Dec. 9, a discussion of "Central-Station Steam Heating Problems" was held. O. L. Le Fever and A. D. Leach of the Northwestern Electric Company were the principal speakers.

NAVY OFFICER ADDRESSES ELECTRICAL LEAGUE.—Commander Bryson Bruce, U. S. N., engineer officer in charge of installation of electrical machinery on the battleship California, addressed the San Francisco Electrical Development League at its luncheon in the Palace Hotel, Dec. 8, on "The Electric Propulsion of Ships." Aubrey Drury, associate editor of the *Journal of Electricity*, acted as chairman.

N. E. L. A., BOSTON EDISON COMPANY SECTION.—James G. Patterson, engineer of the New England Telephone & Telegraph Company, Boston, addressed this company section of the National Electric Light Association on Nov. 17, his subject being "Milestones in Telephone History." The following officers of the section were elected for the coming year: President, J. C. Norcross; first vice-president, J. C. Redmond; second vice-president, J. J. Buckley; secretary, W. S. Holway; treasurer, W. L. Frisbie; executive committee, C. A. White, W. E. Gould, T. E. Penard and S. G. Clough.

Men of the Industry

Changes in Personnel and Position—Biographical Notes

DAVID DALY has been transferred from manager of the Houston (Tex.) Electric Company by Stone & Webster to district manager of the company's Midwest properties, with headquarters at Keokuk, Iowa.

E. L. MILLIKEN, formerly manager of the Houghton County Traction Company of Houghton, Mich., has become manager of the Houston (Texas) Electric Company, succeeding David Daly, who has been transferred by Stone & Webster to Keokuk, Iowa.

PROF. DR. Y. FURUYA of the electrical engineering department of the Kiushiu University, Japan, is visiting the United States on a tour of inspection, studying water-power developments throughout this country. He has recently spent some time on the Pacific Coast and is planning to visit Eastern points later.

RICHARD T. SULLIVAN, for the last five years general manager of the Mahoning & Shenango Railway & Light Company at Youngstown, Ohio, has been appointed manager of the Tacoma (Wash.) Railway & Power Company, the Puget Sound Electric Railway, the Pacific Traction Company and the Tacoma Division of the Puget Sound Traction Light & Power Company, succeeding Louis H. Dean, who resigned Sept. 1 to take up work in New York. Prior to joining the Youngstown company, Mr. Sullivan for many years was general superintendent of railways at Houston, Tex.

HENRY C. ATTWILL, nominated chairman of the new Department of Public Utilities of Massachusetts which succeeds the Public Service and the Massachusetts Gas and Electric Light Commissions, is a member of the Massachusetts Public Service Commission and a former Attorney-General of the state. He was born at Lynn, Mass., in 1872, was educated at Boston University Law School, and since 1893 has practiced law at Boston and Lynn. He has served several terms in the Massachusetts House and Senate, and from 1910 to 1915 was assistant district attorney of the eastern district of Massachusetts. About a year ago he was appointed to the Public Service Commission.

JOHN WEST, who with George P. Carver and Alexander Macomber has recently formed the engineering firm of Carver, Macomber & West, Boston, Mass., was formerly associated with the Tenney interests as new-business manager. Mr. West is a native of Montgomery, Ala., and was educated at Phillips Exeter Academy and Harvard University. After leaving college he spent about three years in the operation of the Edison Electric Light & Power Company, Montgomery. For a year he was with Henry L. Doherty & Company as power engineer of the Joplin (Mo.) central station. In 1910 he joined the Tenney organization at Boston as power engineer, and in 1912 he was made new-business manager of all the Tenney properties. He organized the Tenney Service Association and was active in rate analyses, contract work and street-lighting problems, besides the upbuilding of the sales work of the companies under this management. In 1918 Mr. West was manager of the Hampton (Va.) Shipbuilding & Drydock Company. He is a member of the executive committee of the New England Association of Central Station Power Engineers.

F. E. RICKETTS, the new chairman of the underground systems committee of the Technical and Hydro-Electric Section of the National Electric Light Association, is superintendent of electric stations with the Consolidated Gas, Electric Light & Power Company of Baltimore, Md. Mr. Ricketts has been associated with the Baltimore utility for the last fourteen years, having first been a mechanic, then station operator, from which position he was advanced to chief operator and then to his present position. Mr. Ricketts' other experience in the industry has comprised a few months with the Newport News & Old Point Railway & Electric Company, a year and a half with the Los Angeles & Pacific Railway Company, six months with the Philadelphia Mining Company, Chloride, Ariz., and eighteen months with the Potomac Electric Power Company, Washington, D. C.

F. E. RICKETTS

FRED J. MILLER, who was elected president of the American Society of Mechanical Engineers in New York on Dec. 2, at one time was editor-in-chief of the *American Machinist*, now one of the group of McGraw-Hill technical journals. At that time, however, the *American Machinist* was published by the Hill Publishing Company, of which Mr. Miller was also vice-president. Mr. Miller retired from the publishing business eleven years ago to become general manager of a group of typewriter factories. This position he held until the United States entered the world war, when he promptly offered his services to the government. A commission of major of ordnance was given him, and he was first stationed at the Rock Island Arsenal, where he organized and was in charge of the civilian service division. He was next attached to the office of the Director of Arsenals in Washington, being assigned to duty at the Bethlehem Steel Works, and later in the office of the Secretary of War. Mr. Miller is now a member of the technical advisory committee of the War Claims Board at Washington. He has been a member of the A. S. M. E. since 1890 and has always taken an active interest in its affairs.

Obituary

WILLIAM E. RICE, former president of the Washburn & Moen Manufacturing Company and the Worcester Wire Company, later merged in the American Steel & Wire Company, died on Dec. 2, at the age of eighty-six years.

E. B. GREENE, formerly general superintendent of the Penn Central Light & Power Company, died at his home in Florida on Nov. 25 at the age of sixty years. Mr. Greene entered the electrical field in 1883 as general manager of the Edison Construction Company. In 1886 he became superintendent of the Edison Electric Light Company, Altoona. He remained with this property, through corporate changes, until 1916, when he retired.

FREDERIC P. STEARNS, one of the leading authorities in America upon hydraulics and water supply, died at his home in Boston Dec. 1, at the age of sixty-eight. Mr. Stearns, while primarily a civil engineer, was retained in connection with the Mississippi River Power Company's dam at Keokuk, Iowa, and under his general oversight as consulting engineer of the Metropolitan Water Board of Boston were built the hydroelectric generating stations of Massachusetts at the Clinton and Sudbury dams. He was a member of several scientific societies and had been honored by many educational institutions.

FREDERICK A. CRAMPHORN, assistant manager of the Pettingell-Andrews Company, Boston, died at his home in Woburn, Mass., Nov. 20 after a brief illness. He was born in England about sixty-four years ago and came to the United States when twenty-nine years of age. Mr. Cramphorn was a member of the Engineers' Club of Boston and other organizations of local importance. He was exceptionally well informed upon business conditions and tendencies in the electrical jobbing field, and the ELECTRICAL WORLD has often consulted him upon the broader aspects of trade problems, always receiving his friendly cooperation. He is survived by his widow and a son and also by a brother, James Cramphorn, head of the stock-inventory department of the Pettingell-Andrews Company.

TRADE & MARKET CONDITIONS

News of the Trade for the Manufacturer, Wholesaler and Jobber of Electrical Equipment and Supplies— Notes on Industrial Activities and Business Methods

RENEWABLE FUSES NOW LISTED AS STANDARD

Ratings of Fuses of Economy, Trico, Federal and Chicago Companies Approved by Underwriters

The Underwriters' Laboratories, Inc. as stated in our "Summarized News" last week (page 1124), have now listed as standard a line of cartridge fuses, renewable type, as manufactured in certain sizes by the Economy Fuse & Manufacturing Company, the Trico Fuse Manufacturing Company, the Federal Electric Company and the Chicago Fuse Manufacturing Company, as follows:

Economy, Amp.		Trico, Amp.		Federal, Amp.		Chicago, Amp.
250 Volts	600 Volts	250 Volts	600 Volts	250 Volts	600 Volts	250 Volts
3	3	3	3	3	3	3
4	4	4	4	4	4	4
5	5	5	5	5	5	5
6	6	6	6	6	6	6
8	8	8	8	8	8	8
10	10	10	10	10	10	10
12	12	12	12	12	12	12
15	15	15	15	15	15	15
20	20	20	20	20	20	20
25	25	25	25	25	25	25
30	30	30	30	30	30	30
35	35	35	35	35	35	35
40	40	40	40	40	40	40
45	45	45	45	45	45	45
50	50	50	50	50	50	50
55	55	55	55	55	55	55
60	60	60	60	60	60	60
65	65	65	65	65	65	65
70	70	70	70	70	70	70
75	75	75	75	75	75	75
80	80	80	80	80	80	80
85	85	85	85	85	85	85
90	90	90	90	90	90	90
95	95	95	95	95	95	95
100	100	100	100	100	100	100
110	110	110	110	110	...	110
120	120	120	120	120	...	120
125	125	125	125	125	...	125
150	150	150	150	150	...	150
175	175	175	175	175	...	175
200	200	200	200	200	...	200
225	225	225	225	225	...	225
250	250	250	250	250	...	250
275	275	275	275	275	...	275
300	300	300	300	300	...	300
325	325	325	325	325	...	325
350	350	350	350	350	...	350
375	375	375	375	375	...	375
400	400	400	400	400	...	400
450	450	450	450	...	...	450
500	500	500	500	...	...	500
550	550	550	550	...	...	550
600	600	600	600	...	...	600

All of the renewable fuses above specified have been found by the Underwriters' Laboratories, Inc., to conform to the specifications of the recently adopted standard for renewable cartridge inclosed fuses. Several lines of renewable fuses of other manufacturers are at present before the Underwriters' Laboratories, Inc., and it is expected that further standard listings will be given in the near future if the fuses are found to conform to specifications. Already the "Atlas Four-in-One" fuse, made by the Multiple Electric Products Company, has been approved in sizes of 0 amp. to 200 amp. for 250-volt ratings and 0 amp. to 30 amp. for 600-volt ratings.

THE WEEK IN TRADE

HEAVY buying has characterized the electrical trade manufacturing, distributing and retailing. Seasonable goods in particular have gone with an unprecedented rush, and jobbers' shelves are virtually bare of heaters, tableware and other appliances which are used as gifts.

Stocks in general are low. Besides the above articles, the market is still short of wiring materials in any quantities, although sufficient is available to care for the work in hand. There is a fair supply of tape, fuses, cut-outs, lamps and rubber-covered wire. Factory production of wire is such that premiums have been offered in the East on telephone wire. Heavier demands are being made for motors.

Price increases have been reported on condulets, certain grades of tapes and webbings, sewing machines, white cedar poles, and in the West on fiber sheet and tube. Local prices are in a pretty firm condition.

The Southern district shows increasing bank deposits and a high rate of sales in the more expensive lines of merchandise. Collections are in good shape there.

NEW YORK

Inability to deliver in any quantities for stocking purposes is holding jobbers from accepting large orders from dealers and contractors. In rare instances can a jobber fill an entire order for the general bread-and-butter run of supply materials. Daily wants, however, are being supplied.

Prices are stable among both manufacturers and jobbers. Condulets advanced about 20 per cent on Dec. 20, and certain tapes and webbings advanced earlier in that week in amounts averaging up to 26 points. Stocks in fair volume are reported in condulets, tape, fuses, code wire, lamps and cut-outs, but general shortages are found in tableware, wiring materials and certain types of heaters. Larger stocks of dry batteries could be used by manufacturers to advantage. Steel reflectors and unit lighting fixtures are rather short. From one source comes the report of a better demand for stage and deck cable in sizes around No. 4. Ship repair work is quite heavy.

STEEL REFLECTORS.—R. L. M. type industrial reflectors are moving in increasing volume. Shortage is reported in jobbers' stocks of 100-watt size.

LIGHTING FIXTURES.—Unit lighting fixture stocks are moving well and shortages are occurring in jobbers' stocks.

DRY BATTERIES.—A heavy winter and Christmas demand has lengthened shipments to about three weeks. Stocks in general are short.

LIGHTNING ARRESTERS.—Current sales show a surprising volume for this season of the year. A reason for this is the great demand for distributing transformers. Shipments of small arresters can be cared for from stock, but larger types require up to sixteen weeks.

FANS.—It is expected that prices for 1920 will be from 12 to 15 per cent higher than they were in 1919. Last season's stocks in jobbers' hands are pretty well exhausted. Certain jobbers have already ordered for 1920, while others state they will consider the matter seriously immediately after the Christmas rush.

INSULATION.—Discounts on electrical tapes and webbings last week advanced on averages from 9 to 26 points, according to weight and quality. Certain fine quality webbings and tapes have been taken off the market by one manufacturer.

FRICTION TAPE.—No advance in price has been reported in this territory.

CONDULETS.—A price advance of about 20 per cent went into effect Dec. 20. New York stocks are in good shape.

CONDUIT.—Stocks are sufficient for the moment, with ½-in. black selling for $73 to $80 per 1000 ft.

FLEXIBLE ARMORED CONDUCTOR.—Jobbers' supplies are still extremely short, but sufficient can be picked up for a particular job by judicious shopping. No. 14 is selling for $85 to $90 in single strip for 1000 ft.

TABLEWARE.—Jobbers' stocks during the first part of Christmas week are virtually eliminated. What is left is generally odds and ends.

WIRE.—Manufacturers of rubber-covered wire have not altered their bases recently, the majority remaining on 30 cents. Shipments are around thirty days. Jobbers' prices are holding around $12 and $12.50 per 1000 ft. for No. 14. The trend of increasing business is shown in premiums being offered in certain cases on telephone wire, showing mill production.

CHICAGO

The week before Christmas finds the volume of sales in the electrical trade still holding up remarkably well. The inventories of jobbers when taken at the end of the year will show a very spotty condition of stock. Inventories of retailers will show practically all lines depleted. In St. Louis and Milwaukee stocks which were intended for use in the first months of 1920 are already being placed on the shelves.

Among the central stations, activity in power-house construction seems to be coming to the fore. In Colorado and Chicago central-station projects to the extent of $3,000,000 have been announced. Industrial and residential building is continuing through the cold weather without interruption.

Effects of the coal shortage still continue to make themselves felt. Manufacturers who sell to the central stations received very few inquiries during the coal strike because the central station people were too busy to initiate inquiries, but since the strike has been over these people are apparently making up for lost time, as inquiries are coming in at an increased rate.

Prices generally have been steady during the week.

ELECTRIC IRONS.—It is stated on good authority that electric irons will increase to $7.50 after the first of the year.

LIGHTING REFLECTORS.—The National X-Ray Reflector Company after Jan. 1 will sell its direct-lighting equipment through the jobbers only, except in the cities of New York and Chicago, where the company maintains its own large sales forces. Indirect units of the company will continue to be offered to the electrical trade at one price. The company considers this another step toward meeting the electrical jobbers more than half way.

COPPER WIRE.—The copper market has been steady during the week, with bare wire around a 22-cent base. The majority of Chicago jobbers are on 28-cent base for rubber-covered and some are quoting 30 cents. Weatherproof is steady on a 28-cent base.

CONDUIT.—Some sizes of conduit, notably 3½ in., 4 in. and 5 in., are especially hard to get. The ½-in. size in both black and galvanized is scarce. Other sizes are available.

TRANSFORMERS.—Inquiries for transformers fell off to nothing during the coal strike, because central-station men were too busy doing police duty for coal conservation reasons to initiate inquiries. Since the coal strike has been settled this business has picked up remarkably.

ELECTRIC HEATERS.—Air heaters of the coil and reflector type are difficult to buy in any quantity.

FLOW METERS.—A particularly active market for flow meters is being developed in the Middle West, centering especially in Pittsburgh and Chicago.

BOSTON

No let-up appears in the volume of trade, which many jobbers find exceeds all previous records. Fast-moving stocks are hard hit, with serious shortages in porcelain fittings. Prices are firm, with many forecasts of higher quotations to come. Collections are not so good as usual, taxation burdens being charged with slowing down payments. Retail trade is moving in enormous volume. Building and engineering contracts awarded in New England to Dec. 18 total $235,454,000, compared with $146,703,000 in 1918, and exceeding all totals for the corresponding period since 1900. Important additions to plants or new construction are scheduled by numerous organizations.

MOTORS.—The demand is very heavy. Deliveries on 5-hp. single-phase motors are quoted around three months, stocks being practically exhausted. Motor orders up to 50 hp. are pouring in upon manufacturers at a rate that threatens to absorb the entire 1920 production within a very few weeks.

WIRE.—Base prices are: Bare copper wire, 26 cents; weatherproof, 28 cents; rubber-covered, 28 to 30 cents. No. 14 rubber-covered brings $11.50 per 1000 ft. in 5000-ft. lots. As a rule stocks of the smaller wire are low, a representative plant being about a month behind on orders.

PORCELAIN FITTINGS.—"Nail-it" knobs in standard packages are selling for about $26 per 1000 when obtainable, and 3-in. porcelain tubes for $7.70 per 1000. All porcelain stocks are below normal.

FLEXIBLE ARMORED CONDUCTOR.—A slight improvement in supply is evident, with steady prices. Current quotation is $85 per 1000 ft. for No. 14 single-strip. The demand is very active, and here and there a jobber has a fairly good stock for the time being.

DRY CELLS.—Prices are firm at $32.90 for No. 6 cells and $33.90 per 100 on the ignition type. It is doubtful if the present shortage will be made up for a few weeks, and there is some uncertainty about catching up even then.

LAMPS.—Deliveries are now being made chiefly from production. Factory stocks have shrunk considerably since summer, one establishment reporting a cut from 1,500,000 lamps to about 500,000. So far prices remain steady. Orders are being filled on the installment plan.

APPLIANCES.—Jobbers' stocks have been reduced to zero inventories in some lines. Buying is setting in for 1920, but deliveries are not very satisfactory. One large house reported Monday that its holiday trade had thus far exceeded that of a year ago by over 25 per cent. Washers and cleaners are coming in well but do not stay on the selling floor.

ATLANTA

Trade is very brisk, and jobbers and retailers report an insistent demand for all lines of electrical specialties, and a brisk movement on the more expensive lines of heating devices, such as ornamental percolators, teasets and so forth is being noticed particularly. Electric portables of all classes are moving briskly, with the prospect that the supply on hand will be exhausted by the holiday demand. Jobbers report a general slackening in the demand for material other than holiday specialties, but this is purely temporary because of the recent express embargo, the curtailment of industries by the shortage of fuel and the desire of the trade to hold down its purchases during the period immediately preceding the annual inventory. Some complaint is being heard from jobbers on the new express rates as this new classification works a hardship on jobbers doing business in certain localities. Undoubtedly, the question of official protest on these rates by the Southern Jobbers' Association will be discussed at the January meeting.

CONDUIT.—The situation existing for the past several weeks remains unchanged. Stocks show no improvement and prices are being quoted for date of shipment only.

WIRE.—The demand for weatherproof in popular sizes continues to exceed the supply. Stocks of rubber-covered have been somewhat depleted in the sizes from No. 4/0 to 75,000 circ. mil., because industrial plants in the flooded districts have had to replace a great deal of their interior wiring. Shipments on varnished-cambric cable, weatherproof, underwriter and rubber-covered wire in large sizes are reported at from seven to ten weeks, while shipments of No. 4/0 and smaller sizes are somewhat better. A break in the prices is to be noted,

and jobbers are quoting to-day as follows: Rubber-covered, 26 cents base; weatherproof, sizes No. 4/0 to 8, 26 cents base; No. 10, 27 cents base; No. 12, 28 cents base; No. 14, 29 cents base.

POLES.—The demand for white cedar poles remains steady in the face of a general increase in price of 25 per cent on Dec. 18. White cedar poles, 30 ft. 7 in. top, $6.90; 35-ft. poles, $9.30. Shipments are reported fair and stocks in this section are depleted.

SEWING MACHINES.—Despite the report that sewing machines are moving slowly and that stocks in this territory are in good condition, an increase in price of 10 to 15 per cent is being quoted.

DISTRIBUTING TRANSFORMERS.—Jobbers report a continued steady demand for this article, and while stocks are somewhat depleted, shipments continue good on the sizes up to 50 kva., but on all over 50 kva. best shipments quoted are twelve weeks. No shipments on sizes of 200 kva. and over are being promised, except upon factory advice.

SCHEDULE MATERIAL.—The demand for all classes of schedule material continues strong. Twin plugs and separable attachment plugs are particularly active. Sufficient stocks are reported in this territory to supply the demand.

SEATTLE

Seattle retailers as a whole report that holiday sales volumes came up to expectations, in spite of the exeremely cold weather which gripped the Puget Sound territory for nearly a week and which slowed up trade to an alarming extent for several days of that time. However, a majority asserted that sales were not quite so heavy as last year, no doubt because of the closing down of mills and logging camps and the gradual laying off of employees of steel shipyards. At present there is an oversupply of labor in this district, and considerable unrest is being manifested. Shortly after the first of the year Seattle's big steel shipbuilding plants will have practically completed their programs. No new contracts are in sight. Authorization from Washington, D. C., for construction of two 10,600-ton ships at the Puget Sound Navy Yard will mean much for Seattle wholesale electrical dealers, who at present are deriving considerable business of like nature from this source. Building in Seattle apparently has really started. Last week contracts were awarded for $600,000 in a university building, a church and three business buildings. Lumber mills in Oregon and Washington are daily being forced to close down on account of car shortage.

The Portland district reports both wholesale and retail electrical business good. Christmas shopping was well sustained and in heavy volume, the majority of sales being domestic appliances. Spokane territory states that jobbers' business is excellent. With a serious shortage of merchandise, retail sales volumes are heavy and Christmas sales considerably heavier than originally anticipated. Tacoma jobbers report holiday business on a par with last year's sales volume. Tableware, particularly percolators, toasters and chafing dishes, was the best seller, although washing machine, flatirons, vacuum cleaners and heaters moved exceptionally well. Stocks in certain of these lines have been reduced to a minimum.

SAN FRANCISCO

The winter rains have caused a temporary cessation of building. Labor conditions are assuming a more normal aspect, although the shipyard strike is holding out a lot of men and certain river boats plying between San Francisco and interior cities have been temporarily discontinued because of the stevedore strike. Shipments from the East have been exceedingly slow, requiring five or six weeks.

SEWING-MACHINE MOTORS.—A departure has been made on the basis of selling sewing-machine motors. The Hamilton Beach line has been increased 50 cents to cover Western delivery, making the list price $18.50. The new dealers' price is $13.50 in small quantities. There has been a wonderful demand for these motors, most houses being sold out.

HAIR DRYERS.—An increased number of calls have recently been received for hair dryers, with practically no stock to take care of the demand. The calls are well scattered and are traceable to no single source of demand.

DRINK MIXERS.—Difficulties of delivery considerably hampered the electrical jobbers during the greater part of the year. Sales of drink mixers have not been up to expectations considering the increase in the number of soda fountains, and the business possibly has been going to some other source of supply.

WIRING DEVICES.—The demand has slackened off somewhat during the winter, although local agents are far behind in their shipments. Fuse prices have slightly changed, they selling in package lots in small capacities, 250-volt size, for about 32½ cents each. The demand for refillable fuses has dropped off considerably. It is predicted that the big increase in the number of factories on the Pacific Coast, which is appreciable now, will require many fuses during 1920 for complete initial installations.

FIBER.—Fiber sheet and rod has taken a good jump, full sheets now selling in the one-sixty-fourth size for 80 cents per pound and in the one-eighth size for 70 cents per pound as compared with former prices of 70 cents and 61 cents per pound. Deliveries and demand are fair.

POLE-LINE HARDWARE.—The demand is not very large, but orders are being placed in expectation of a big 1920 demand.

METAL MARKET SITUATION

Copper Market Strong at 18.50 to 18.75 Cents—Lead Advances 15 Points, Sheet Zinc ½ Cent

Throughout the past week copper has held rather strong at 18.50 cents a pound with some agencies selling at the end of the week at 18.62½ and 18.75 cents. Domestic buying has been in quite large quantities. Most of the sales, it seems, are for January and February delivery as spot consumption is well cared for. There is even a tendency to buy for second quarter, but the producers are not showing a very favorable attitude toward this feature at present prices.

Buying for foreign markets is also in good volume at a rate of 19 to 19¼ cents a pound. France and England, even with their large surplus, have bought well in copper wire and bar.

Lead quotations have again been advanced, this time 15 points to 7.15 cents per pound in New York. This is the third advance this month and the twelfth successive advance since the middle of last May. In the outside market, with demand still much in excess of supply, 7.25 cents is being bid and 7.35 cents asked. Rising prices are expected to more nearly equalize the demand with supply, and it is probable that the balance is about reached. Scrap lead is up ⅛ cent.

The market in zinc is virtually unchanged. Sterling exchange fluctuations have made it almost impossible to do any foreign business this past week. Sheet zinc, however, is ½ cent higher at 11.50 cents a pound. This step brings the domestic price up to the foreign price.

Tin is slightly higher at 54.25 cents for spot Straits. The next few months are sufficiently well taken care of with present supplies.

NEW YORK METAL MARKET PRICES

	Dec. 15	Dec. 20
Copper:	£ s d	£ s d
London, standard spot	102 17 6	104 0 0
	Cents per Lb.	Cents per Lb.
Prime Lake	19.00	19.12½
Electrolytic	18.50	18.62½
Casting	18.25	18.37½
Wire base	21.50 to 22.00	21.50 to 22.00
Lead, trust price	7.00	7.15
Antimony	9.62½	9.75
Nickel, ingot	41.00 to 42.00	41.00
Sheet zinc, f. o. b. smelter	11.00	11.50
Spelter, spot	8.55 to 8.60	8.60
Tin	53.75	54.25
Aluminum, 98 to 99 per cent	32.00 to 33.00	32.00 to 33.00

OLD METALS

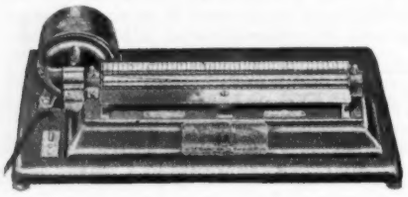
	Cents per Lb.	Cents per Lb.
Heavy copper and wire	17.00 to 17.50	17.00 to 17.50
Brass, heavy	9.50 to 10.00	9.50 to 10.00
Brass, light	7.75 to 8.25	7.75 to 8.25
Lead, heavy	5.75 to 6.00	5.875 to 6.125
Zinc, old scrap	5.00 to 5.25	5.00 to 5.25

NEW APPARATUS & APPLIANCES

A Record of Latest Developments and Improvements in Manufacturers' Products Used in the Electrical Field

Electrically Operated Letter Opener

An electrically operated letter opener known as the "Ries O.K.," model E, has been developed by the O. K. Manufacturing Company of Syracuse, N. Y. A



MOTOR AND CUTTING CYLINDER CONNECTED BY DIRECT WORM GEAR

Holtzer-Cabot electric motor is connected to the cutting cylinder of the machine by a direct worm gear so that the shearing edges are presented at the cuttitng edge of the shear-plate about 600 times a minute.

The dimensions of the new letter opener are 11 in. (27.9 cm.) by 21 in. (53 cm.) and the weight is 25 lb. (11 kg.). Motors for either alternating current or direct current of different voltage, phase and cycle can be obtained with the machine, which is equipped with a switch and 6 ft. (1.8 m.) of insulated copper-feed wire together with a connecting plug.

Motor-Driven Valve Grinder

An electrically driven automobile-valve grinder has been put on the market by D. F. Dunham, 830 West Thirty-seventh Street, Los Angeles, Cal., for the use of garages and automobile owners. It is equipped with a 1/12-hp. high-speed Westinghouse motor of standard construction, mounted upon a rigid base, and may be connected to any lamp socket through a drop cord and plug. A snap switch controls the motor.

While the new machine was designed primarily for valve facing, with an extra hub and wheel, it can be used for grinding small tools such as drills and chisels.

Narrow Safety Push-Button Panel

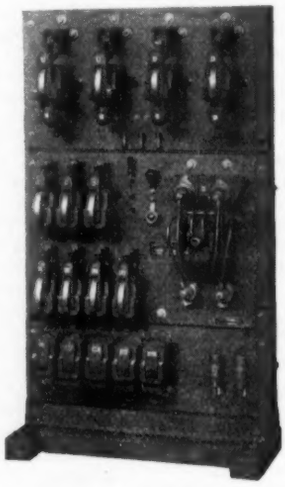
A safety lighting panel of small capacity for apartment houses, residences, etc., has been developed by the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa., and is known as its type "C" safety panel.

These panels are made up of push-buttons and plug fuses, and all parts accessible are electrically dead, so that the operator is in no danger of getting a shock in turning the lights on or off. Each pair of buttons with its fuses constitutes a unit, and should a switch become damaged, all that is necessary, it is stated, is to remove the switch-cover section and unscrew the defective part, without disconnecting any wires, exposing other switches or removing the panel from the box. This panel is said to be very narrow and can be furnished with a safety-type main switch if desired.

The new panels are made for two-wire or three-wire systems and for from two to thirty-two branch circuits. The capacity of the main ranges from 30 amp. to 200 amp., 125 volts, and the capacity of each branch circuit is 10 amp.

Panelboard Direct-Current Elevator Controller

All pilot contacts and dash-pots have been eliminated in the type V direct-current master controller for elevator motors which has been brought out by the



FUSES INSTEAD OF CIRCUIT BREAKERS PROTECT MOTORS

Warner Elevator Manufacturing Company of Cincinnati, Ohio.

The main line contacts of the new panelboard controller are of the butt type, copper to copper, and are designed for long life under heavy traffic.

All contacts are operated by individual magnets, thus eliminating the necessity for insulating the contacts. Accurate floor stops are said to be easily made through the operation of this controller with the use of but four wires from the car switch to the controller. Fuses are provided to protect the motor against overload. A potential switch is furnished to open the main line in case of excess speed, over-travel or low voltage.

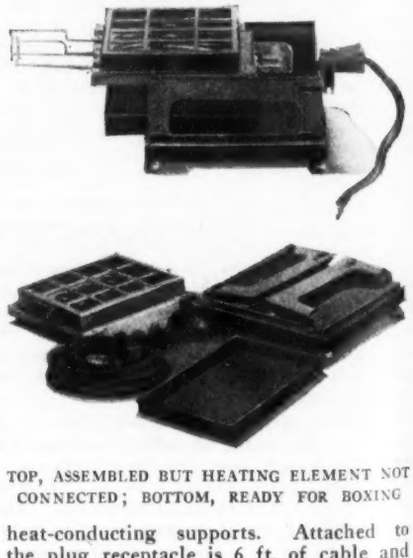
Folding Electric Table Stove

A portable electric stove for toasting, frying, boiling and grilling that folds up to occupy a box 2½ in. (6.2 cm.) high by 6 in. (15 cm.) square has been developed by the Calorex Corporation, 12 West Twenty-second Street, New York City. The new stove's essential parts are a removable heating element, a base with folding sides and end, a grilling, boiling or frying pan, and the necessary cable and connections.

No switch is required on the cable circuit, as the heating element slides in and out of the stove's frame and in so doing its terminals make or break contact with the plug receptacles. Owing to this sliding feature the heating element may be reversed for grilling purposes with the pan placed underneath on top of the base. The insulating plate of the heating element carrying the resistance wires and terminal plugs may be removed from its incasement, should it become burned out or damaged, and another inserted.

To fold up the stove the heating element is slid out of the frame and its handles are folded along the sides of the element case. The grilling pan fits over the top of the heating-element case while the sides and end of the base fold down. The heating element and the pan are then fitted under the hollow base while the cable and connections are adjusted on top.

The stove is constructed of stamped steel, nickel-plated. The base has non-



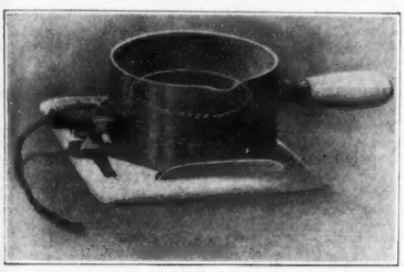
TOP, ASSEMBLED BUT HEATING ELEMENT NOT CONNECTED; BOTTOM, READY FOR BOXING

heat-conducting supports. Attached to the plug receptacle is 6 ft. of cable and an attachment plug. The stove is operated on alternating current or direct current of 110 to 120 volts.

Rapid Heating Cup for Liquids

To heat a pint of water or other liquid in two minutes the Calorex Corporation of 12 West Twenty-second Street, New York City, has placed on the market an electrically heated cup for use in homes, restaurants, hospitals and other places. Aside from the feature of rapid heating, the maker points out that the cup has a watertight construction so that it can be immersed in water for cleaning without risk of damage to the heating element.

The cup is of copper, plated with either nickel or silver, with a white-enameled or polished black handle, and is 3¼ in. high and 4¼ in. in diameter. Suspended in the cup with ample clearance from its sides, as indicated by the dotted lines in the accompanying picture, is a circular metal-incased electric heating unit 1 in. high and 3/32 in. thick. The terminals of the element pass out of the cup, and opposite the handle, to terminal plugs fitted in water-tight insulation.



PLUGS ON CUP CONNECT WITH PLUG RECEPTACLE ON BASE

With the new heating cup, which operates on 110 volts or 120 volts, alternating current or direct current, are supplied 6 ft. of cable and an attachment plug.

Marine Lighting Generators

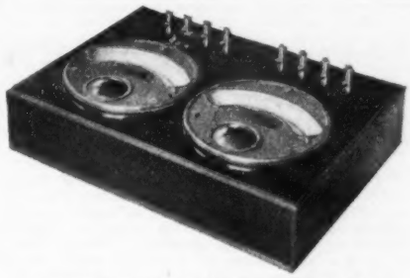
A line of marine lighting outfits ranging in size from 2 kw. to 50 kw. and consisting of a steam engine coupled to an electric generator has been placed on the market by the Westinghouse Electric & Manufacturing Company of East Pittsburgh, Pa.

The steam engine used in these sets is manufactured by the Clarage Fan Company. The generator, while in general of standard Westinghouse construction, is built specially for marine service. Its bearings are designed for perfect lubrication regardless of the tossing of the vessel. The windings are specially insulated to protect them from salt and dampness, and the metal parts subject to corrosion are of non-corroding alloys. A special feature of these generators pointed out by the maker is their freedom from sparking even under heavy overloads. They are supplied for either 125 volts or 250 volts, direct current, and for either two-wire or three-wire systems.

The 15-kw. size of these marine lighting generators is 6 ft. (1.8 m.) long, 3 ft. (0.9 m.) wide and 5 ft. (1.5 m.) high, and the device weighs about 3300 lb. (1496 kg.)

Volt-Ammeter Set

A volt-ammeter set embodying voltage ranges of 0 to 1.5, 0 to 15, and 0 to 150, and an ampere capacity of 0.05, 0.5 and



TEMPERATURE COEFFICIENT IS SMALL

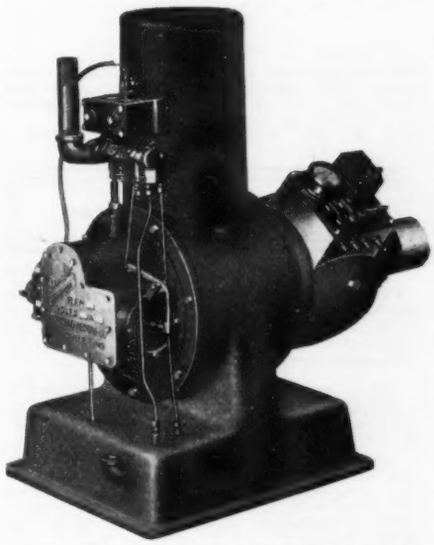
5, has been announced by the Pyrolectric Instrument Company, 636 East State Street, Trenton, N. J.

The instruments made by this company, it is claimed, are accurate to within one-fifth of 1 per cent of full-scale reading at every point on each range. The temperature coefficient is small, being one-twenty-fifth of 1 per cent per degree Centigrade.

Compact, Direct-Connected Light and Power Plant

An unusually compact farm lighting and power plant, in which the engine and generator are directly connected and, together with the switchboard, are mounted on a single base, which is a fuel tank, has been brought out by the Drury Engineering Company of Evansville, Ind., and the company lists it under the name "Drualite."

The plant, which has the low speed of 700 r.p.m., is rated to deliver 1200 watts.



SWITCHBOARD MOUNTED DIRECTLY ON PLANT

It is designed to be free from voltage changes and from the consequent flickering lights.

The plant has a pulley which is said to deliver 3½ hp. to a belt installed for the purpose of driving pumps and other machinery.

Recent Appliances

Rail-Cutting Machine

The Racine Tool & Machine Company of Racine, Wis., has developed a motor-driven machine for sawing rails.

Piston Regrooving Tool

The Splitdorf Electrical Company of Newark, N. J., is manufacturing the Munger tool for regrooving the pistons of engines.

Motor-Driven Saw Bench

A direct-motor-driven saw bench with a tilting arbor has been brought out by Baxter D. Whitney & Son, Inc., Winchendon, Mass.

Boudoir Lamp

The Riviere Brass & Bronze Company, 241 West Twenty-third Street, New York City, has brought out a portable electric boudoir lamp.

Motor-Driven Ironing Machine

A motor-driven, foot-pedal-controlled ironing machine has been brought out by the Keystone Ironing Machine Company of Pittsburgh, Pa.

Tiering Electric Truck

An electric truck for combined transportation and lifting has been developed by the Elwell-Parker Electric Company of Cleveland, Ohio.

Instantaneous Water Heater

The Bridgeport Machine & Tool Manufacturing Company of Bridgeport, Conn., is now making the "Everhot" instantaneous electric water heater.

Pole Pulling and Straightening Jack

The No. 328 "Simplex" pole-pulling and straightening jack has been placed on the market by the Templeton, Kenly Company, Ltd.

White-Glass Nitrogen Lamp

The Nitrogen Electric Company of 46 Spring Street, Newark, N. J., has developed its "Opal Snowite" nitrogen lamp, which is made in 50-watt and 25-watt sizes.

Home-Size Dishwasher

An electrically driven household-type dish-washing machine, known as the "Mermaid," has been developed by the Wolcott Manufacturing Company of Hartford, Conn.

Brass Fixture Connector

For making small electrical connections without the use of solder the H. B. Sherman Manufacturing Company of Battle Creek, Mich., is now manufacturing a brass-fixture connector.

"Daylight" Attachment for Desk Lamps

A. G. McFaddin & Company, 36 Warren Street, New York City, have placed on the market a "Daylight" glass screen for attachment to the shades of their "Emeralite" desk lamps.

Manufacturers' Activities

YEOMANS BROTHERS COMPANY, Chicago, manufacturer of electric pumping machinery, has announced the removal of its general offices and factory to its new building at 1433 Dayton Street, where improved facilities of manufacture and supply are available.

MAJOR WALTER E. KRUESI has returned from service and is in charge of the import department of Frazar & Company, New York City. Lieut. Frank E. Kruesi, formerly of the Middle West Utilities Company, Chicago, is in charge of the Pacific Coast branch of Frazar & Company, with offices in Seattle, Wash.

RAW ASBESTOS SUPPLY SHORT.—According to "Asbestos," the monthly market journal of the asbestos and magnesia industries, raw asbestos, without which production would be impossible, is insufficient to meet current needs, and owing to the nature of the deposit it is very unlikely that there will be a surplus for a long time to come.

THE ALLIS-CHALMERS MANUFACTURING COMPANY reports sales of $7,557,683 in the quarter ended Sept. 30, 1919, compared with $6,212,290 in the corresponding quarter of the year before. Net profits were $916,309, against $1,170,296 in three months ended Sept. 30, 1918. Unfilled orders on hand on Sept. 30, 1919, amounted to $14,542,704, compared with $32,382,335 at the same time in the preceding year.

WITHERBEE IGNITER COMPANY EXPANDS.—The Witherbee Igniter Company, Springfield, Mass., has leased the plant of the Springfield Chemical Company on Liberty Street and has begun the manufacture of storage batteries at the new site. A service station has also been established at 1199 Liberty Street, with facilities for the charging and repair of batteries and other equipment. The main building of the company at 132 Liberty Street will be devoted to the manufacture of magnetos for stationary engine ignition. The factory personnel is being enlarged by 25 per cent.

NEW ENGINEERING FIRM ORGANIZED AT BOSTON.—The firm of Carver, Macomber & West has been organized with offices at 261 Franklin Street, Boston, Mass., to conduct a general consulting engineering business, including designs, supervision of construction and appraisals. George P. Carver, Alexander Macomber and John West are the partners in the new establishment. Mr. Carver for the past twelve years has conducted a general engineering practice in Boston, specializing in coal-handling and fuel problems, while Mr. Macomber and Mr. West have been associated with Chas. H. Tenney & Company, the former as electrical engineer and later assistant engineering manager, and the latter as new-business manager of all the Tenney properties.

MALLORY INDUSTRIES, INC., recently formed to consolidate a number of interests controlled by Philip R. Mallory, Port Chester, N. Y., has purchased the entire capital stock of the Crystal Washing Machine Company of Detroit, Mich. The output of the Detroit plant has been more than doubled, and provision has been made for manufacturing Crystal washing machines in the Port Chester works of the company, giving a combined output of 60,000 machines during 1920. In addition, Mallory Industries, Inc., has just completed arrangements for the manufacture of 60,000 additional Crystal machines in another affiliated plant, making a total 1920 output of 120,000 machines. F. C. Sebulske, to whose energy and ability is due the development of the Crystal machine, remains with the company as its secretary. The officials of Mallory Industries, Inc., are: R. P. Mallory, president; F. K. Leatherbee, vice-president and treasurer; F. E. Seeley, vice-president in charge of production, and C. A. Magee, vice-president in charge of sales. Mr. Magee was formerly general commercial manager of the Consolidated Gas & Electric Company of Baltimore, Md.

THE DAYTON FAN & MOTOR COMPANY, Dayton, Ohio, announces the appointment of Warner Jones as sales manager, effective Oct. 1. In Mr. Jones' twenty years of experience in the electrical business he has come in contact with many supply jobbers in all parts of the country. Part of this experience was in connection with managing the electrical department of the H. W. Johns Manufacturing Company, as special sales representative of

WARNER JONES

the Nungesser Carbon & Battery Company and special representative of the National Carbon Company, which latter association he recently severed.

Supply Jobbers' Notes

THE LEWIS ELECTRICAL SUPPLY COMPANY, Boston, has executed an agreement with the Westinghouse Electric & Manufacturing Company to handle the resale products of the latter in the New England territory.

THE EASTERN ELECTRIC SUPPLY COMPANY has been organized with offices at 45 Market Street, Portland, Me. E. D. Tribou, formerly of Augusta, Me., is president; G. D. Montgomery, vice-president and general manager, and H. W. Holmes, Portland, is treasurer. The company will carry on an electrical supply jobbing business without catering to the retail trade.

VAN B. MARKER and F. R. EISEMAN announce the incorporation with $100,000 capital of the Revere Electric Company, to be located at 439 Plymouth Court, Chicago. This company will start operation on Jan. 1, 1920, as jobber of high-class standard lines of electrical merchandise. It will occupy a four-story building having 12,500 sq. ft. of floor space. Mr. Marker has been in charge of the Chicago office of the Adams-Bagnall Electric Company, having been with this company for ten years. Mr. Eiseman has been with the Electric Appliance Company of Chicago for about fifteen years and has been city sales manager for the last five years. He was formerly with the Central Electric Company, Chicago. Associated with these two will be R. A. Tellisch, who has been Mr. Eiseman's assistant sales manager at the Electric Appliance Company.

Foreign Trade Notes

FINLAND NEEDS ELECTRICAL GOODS.—One of the important needs of the Gamlakarleby district in Finland is electrical goods of all kinds. Germany formerly supplied this trade.

REMOVAL OF BRITISH EMBARGO ON WIRELESS APPARATUS.—A cablegram from Consul General Hollis, London, dated Sept. 11, announces that the British export embargo on wireless telephone and telegraph apparatus and instruments has been removed.

BELGIAN PURCHASING AGENCY.—Co-operative purchasing bureaus have been established in Belgium under the auspices of the Belgian Ministry of Reconstruction. Manufacturers should address the Société Coopérative, Fédération des Centrales d' Electricité de Belgique, 158 Rue Royale, Brussels, for the supply of iron, steel or metal-working equipment for power plants.

RESTRICTIONS ON ELECTRICITY IN FRANCE SOON TO BE CANCELED.—The decree of Nov. 21, 1916, limiting the use of electricity other than for factories working for war purposes will be canceled on the day officially designated as mark-ink the cessation of hostilities. This measure will not apply to the following French departments: Nord, Somme, Pas-de-Calais, Oise, Aisne, Marne, Ardennes, Meuse, Meurthe-et-Moselle, Vosges. In these departments electric power will continue to be distributed under the supervision of a departmental commission.

ELECTRIC LAMP MONOPOLY IN ITALY.—The "Gazzetta Ufficiale" for Sept. 6 publishes the full text of the decree establishing a monopoly of electric lamps. Twenty-five per cent of the commercial value of all electric lamps must be paid to the State. Small factories producing less than 10,000 lamps per year may pay the tax in the form of an annual subscription. Lamps of foreign origin will incur the taxation when cleared at the customs. New factories require a license. The lamp factories will be inspected by customs and excise officials.

LACK OF RAW MATERIALS IN ENGLISH MARKETS.—English manufacturers are far behind on raw materials. According to advices from the other side, this does not apply merely to individual manufacturers but to manufacturers as a whole. Instances have shown that some of these manufacturers have failed in their attempt, through their agents in America, to get more raw materials over to England. They are anxious to rebuild and even extend pre-war reputation and trade in all markets, but owing to the difficulty of getting supplies their production has been badly curtailed. One result of this lack of raw materials has been the curtailing of advertising to the lowest possible limit.

DUTCH ELECTRICAL IMPORT DUTIES.—The Netherlands Ministry of Finance has passed the following resolution regarding import duties on electrical goods: All switches, controllers, starting switches, regulating resistances and other resistances, insulators and transformers, if it is shown to the satisfaction of the examining customs officers, if desired by means of the production of drawings, orders and other documents at the time of the customs examination, that they are to be regarded as parts or appurtenances of factory machinery or of the plant of electric central power works, are admitted free. Cable boxes, transformer tanks and

similar plant distributed over the network of cables for the distribution or transformation of electrical energy are regarded as forming a whole with the central power works.

THE BRITISH THOMSON-HOUSTON COMPANY, LTD., HAS HEAVY SALES.—Following its directors' report for the year 1918, H. C. Levis, chairman of the board, stated that the company was completing the largest turbo-generator ever built in England (30,000 kw.) and two of the largest electric equipments for steel rolling mills ever built anywhere. The company's orders for the first half of 1919 were larger than for any similar period in the history of the company. He hesitated to say anything about the general situation, particularly in view of the evidences of unrest which were apparent in so many directions, but looking to the past history of the country he could not help feeling that it would be a passing phase which would be settled by readjustments along reasonable lines. "One thing must be fully recognized," said Mr. Levis, "and the sooner it is learned the better, and that is that England must produce a larger output at reasonable costs, or the country will not be able to sell in foreign markets."

S. A. REDDING, formerly general superintendent of the electrical department of the Georgia Railway & Power Company, has gone to Rio de Janeiro, Brazil, as representative for the Ohio Brass Company, Delta-Star Electric Company, Crouse-Hinds Company, Cheatham Electric Switching Device Company, Nachod Signal Company, G. & W. Electric Specialty Company and the Columbia Machine Works & Malleable Iron Company. Mr. Redding had been in Brazil from 1898 to 1903, after which time he was associated with the Georgia Railway & Power Company and its predecessor, the Georgia Railway & Electric Company, continuously until Feb. 15, 1919, as assistant electrical engineer, electrical engineer and general superintendent of the electrical department. He resigned on this latter date in order to take up commercial and industrial work in South America. While with the Georgia Railway & Power Company he had general supervision over the steam and water-power production, transmission lines and all maintenance in the electrical departments, as well as all engineering and construction.

THE DALYTE ELECTRIC, LIMITED, Guelph, Ontario, Can., announces that it has received its Dominion charter, with authorized capital of $1,000,000. This is an amalgamation of the Flexible Conduit Company, Ltd., formed during 1911, the output of which is at present ten times the original output; the Munder Tungsten Lamp Company, Ltd., founded in 1914 to manufacture tungsten lamps, which also has greatly increased its production in the last five years, and the Dalyte Lamp Company, Ltd., formed in 1917 to manufacture nitrogen-gas-filled lamps. These three companies were located in the same factory building under the management of J. S. Wheeler, with one office staff and owned by one group of stockholders. The new company owns the factory building and real estate in connection therewith and is now installing equipment to double again the production in all departments. Sales offices have been opened in all the principal cities in Canada. The new company is under the same managements as the old companies, and the officers and directors were elected from the three groups of officers and directors of the old companies.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered, further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

The purchase is desired by a manufacturing company in Belgium (No. 30,966) of motors, three-phase, 40 cycles, 220 volts, controllers, starters, resistors, distribution tables, transmission equipment and railroad equipment, narrow-gage (60 cm.). Quotations should be given c. i. f. Antwerp. Correspondence may be in English.

A firm in Denmark (No. 31,028) desires to secure general agencies for the sale in Scandinavia and in Germany of electrical articles.

An engineer in Italy (No. 30,932) desires to secure an agency for the sale of electrical goods. Correspondence may be in English.

An indent agent of wide experience and connections in Australia (No. 31,050) desires American agencies in engineering lines, including generators.

A firm in Norway (No. 31,045) desires to secure an agency and purchase electrical supplies. Quotations should be given c. i. f. Norwegian port. Payment through banks.

A firm in Norway (No. 30,992) desires to secure an agency for the sale of electric fixtures, elevators and hoisting machinery. Quotations should be given c. i. f. Norwegian port. Terms, preferably ninety days.

An agency is desired by a man in Italy (No. 31,023) for the sale of electrical materials of all kinds, especially those for illuminating purposes and electrical locomotives. In all cases where possible samples and catalogs are desired. Quotations should be given c. i. f. Italian port. Payment, cash against documents. Correspondence should be in Italian.

A commercial agent in France (No. 31,386) desires to secure an agency on a commission basis for the sale of electrical apparatus, such as wire, insulators, switches, lamps, reflectors, meters, bells and electrical fans. Quotations should be given c. i. f. French port. Payment, cash against documents, and at three months.

Trade Publications

REFLECTORS.—Harvey Hubbell, Inc., Bridgeport, Conn., has issued circular No. 184 on reflectors for industrial lighting.

FLOOD LAMP. — The Brenkert Light Projection Company of Detroit, Mich., tells about its "Crescent B" spot-flood lamp in an illustrated folder.

GRAPHIC METERS.—"Graphic Meters for General Testing" is the title of a booklet which the Esterline Company of Indianapolis, Ind., has issued.

ELECTRIC FURNACES.—Bulletin No. 70-B has been published by the Electric Furnace Company of Alliance, Ohio, and covers electric furnaces in brass mills.

FLUID METERS.—Fluid meters and low-pressure gas and air are the subjects of bulletin No. 30 recently published by the Bailey Meter Company of Cleveland.

WATER PUMPING. — The Ingersoll-Rand Company, 11 Broadway, New York City, is circulating a mailing folder descriptive of its air-lift method for pumping well water.

HOUSEHOLD APPLIANCES.—A folder has been prepared by the Western Electric Company of New York City to describe and illustrate a number of its household electrical appliances.

FARM-LIGHTING PLANTS. — The A-C Electrical Manufacturing Company of Dayton, Ohio, has issued a booklet covering "Dayton" country home-lighting systems, dynamos, batteries, etc.

WATER-SUPPLY SYSTEMS. — The Vaile-Kimes Company of Dayton, Ohio, has issued catalog F, entitled "The Modern Way," to tell about its electrically operated water-supply systems.

ELECTRIC FURNACES.—The Electric Furnace Company of Alliance, Ohio, has issued a booklet containing a paper delivered by T. F. Baily at a recent meeting of the American Institute of Chemical Engineers entitled "Resistance Type Electric Furnaces for Melting Non-Ferrous Metals."

HEATING PAD.—The Goodwill Electric Company, 59 East Van Buren Street, Chicago, has issued several folders describing its electric heating pad.

POLE JACK.—The No. 328 "Simplex" pole pulling and straightening jack is the subject of a folder from Templeton, Kenly & Company, Chicago and New York City.

CARPET WASHER. — The Hamilton-Beach Manufacturing Company, Racine, Wis., has prepared an illustrated folder about its new electrically operated carpet washer.

FRICTION CLUTCHES.—The Medart Patent Pulley Company of St. Louis, Mo., has issued a booklet entitled "The Clutch That Clutches" about its V-groove friction clutch.

HIGH-FREQUENCY GENERATORS.—The Bleadon-Dunn Company of Chicago has issued a leaflet that describes its new "Multifrex" high-frequency generator for medical use.

SOLDERING.—The M. W. Dunton Company of Providence, R. I., has just published the fourth edition of its "Soldering Kinks," a 116-page book containing many uses for solder.

NAVAL EQUIPMENT. — The General Electric Company of Schenectady, N. Y., has issued its bulletin No. Y-1307, entitled "The Electric Ship," dealing with electric ship propulsion.

VACUUM CLEANER. — The Cadillac electric vacuum cleaner is the subject of an illustrated booklet which has been prepared by the Clements Manufacturing Company of New York and Chicago.

CURRENT DETERMINATOR. — Type 1050 Majestic current and voltage testing device is covered in a circular recently prepared by the Majestic Electric Development Company, 1705 Allegheny Avenue, Philadelphia, Pa.

ELECTRIC RANGE.—The Hughes Division of the Edison Electric Appliance Company, 5660 West Taylor Street, Chicago, has issued its electric range sales service manual of forty-seven pages.
manuel of forty-seven pages.

New Incorporations

THE W. D. HILL ELECTRIC COMPANY of Xenia, Ohio, has been incorporated with a capital stock of $10,000 by D. C. Wright and others.

THE MARION (KY.) LIGHT, ICE & COAL COMPANY has been incorporated with a capital stock of $40,000 by T. H. Cochran, Samuel Gugenheim and O. S. Denny.

THE ALBEMARLE (N. C.) TELEPHONE & ELECTRIC COMPANY has been incorporated with a capital stock of $10,000 by J. C. Munden and C. E. Thompson of Elizabeth City and others.

THE SOUTHERN TIER ELECTRICAL SUPPLY COMPANY of Binghamton, N. Y., has been incorporated with a capital stock of $35,000 by A. H. and E. A. Hyle and E. C. Wehle of Rochester, N. Y.

THE BURNSVILLE (N. C.) ELECTRIC COMPANY has been incorporated by William C. Skaggs and others to construct and operate an electric light and power plant in Burnyville. The company is capitalized at $15,000.

THE W. E. NICHOLS COMPANY of New York, N. Y., has been incorporated by R. S. King, O. A. Schramm and K. M. Nichols. The company is capitalized at $50,000 and proposes to do a general contracting and electrical business.

THE JOEL ELECTRIC COMPANY of Clayton, Wis., has been incorporated by Menus Johnson, F. J. Andersohn and Charles E. Paulson. The company is capitalized at $20,000 and proposes to generate and distribute electricity.

New England States

HERMON, ME. — The Black Stream Electric Company is contemplating the erection of 1 mile of feeder line. The company purchases energy from the Bangor (Me.) Railway & Electric Company. E. P. Snow is superintendent.

NORTH STRATFORD, N. H. — Contract has been awarded to C. A. Ridlon of Roulette, Pa., for a power house, 75 ft. by 80 ft., and barrel factory, 65 ft. by 120 ft., to be erected at the local plant of the Warner Sugar Refinery Company, 79 Wall Street, New York, N. Y.

BELCHERTOWN, MASS. — Work has begun on the construction of the proposed power plant at the State School for Feeble-minded in Belchertown.

CHICOPEE FALLS, MASS.—The New England Wesinghouse Company contemplates the construction of an addition to its plant at East Springfield for the manufacture of small motors. The cost is estimated at about $150,000.

NEWPORT, R. I.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Jan. 9, 1920, for furnishing, under Schedule 5226, one electric transportation truck; Schedule 5227, seven electric trolley hoists. Puget Sound, Wash., Schedule 5238, one tension meter, one revolution counter and one engine log system.

PAWTUCKET, R. I.—The proposed new factory of the Tubular Woven Fabric Company, it is understood, will be equipped with electrically operated machinery. The cost, including equipment, is estimated at about $200,000.

WESTERLY, R. I. — The Westerly Light & Power Company will soon erect a new transmission line from Hope Valley to Arcadia, a distance of about 3 miles. The company also expects in the very near future to purchase at least part of its energy from the Eastern Connecticut Power Company at Montville. M. H. Spellman is general manager.

MYSTIC, CONN.—The Mystic Power Company is revamping lines between Mystic and Noank, Conn., by running a short cable across the Mystic River. M. H. Spellman of Westerly, R. I. is general manager.

WATERBURY, CONN. — A turbine in the local power plant of the Connecticut Light & Power Company was destroyed by an explosion recently.

Middle Atlantic States

AMENIA, N. Y.—The Amenia Electric Light & Power Company has petitioned the Public Service Commission for approval of a franchise to operate an electric light and power plant in Amenia, for which plans are now being prepared.

CALEDONIA, N. Y.—The Village Trustees are considering replacing the gas lamps now in use with electric lamps. Negotiations are under way with the Livingston-Niagara Power Company of Avon. The Water Commissioners are also considering equipping the water pumping station with electrically operated machinery.

CONESUS, N. Y.—The Wayland (N. Y.) Light & Power Company has been granted a franchise to construct and operate an electric light plant in Conesus.

PORTVILLE, N. Y.—Application has been filed with the Public Service Commission by the Portville-Cattaraugus County Utilities Company for permission to construct and operate an electric light and power plant and to issue $50,000 in bonds, the proceeds to be used for the proposed work. The company has been granted a franchise by the town officials.

ROCHESTER, N. Y.—Plans have been prepared by G. Morton Wolfe, architect, 1377 Main Street, Buffalo, for the erection of a power plant and boiler house, 50 ft. by 100 ft., on Humboldt Street for the Josiah Anstice Company, 220 North Water Street.

Construction

News of Projects, Plans, Bids and Contracts. Notes on Work Under Way

ROCHESTER, N. Y. — Negotiations have been completed by the General Electric Company of Schenectady for the plant of the Symington Company on Leighton Avenue. It is proposed to utilize the plant, which provides about 125,000 sq. ft. of space, for the manufacture of electrical equipment.

SOLSVILLE, N. Y.—The Public Service Commission has granted the Solsville Electric Light & Power Company permission to make extensions to its local plant. The company will also acquire the local hydroelectric plant.

WAYLAND, N. Y.—The Wayland Light & Power Company has been granted permission to build an addition to its plant at Wayland and also to construct and operate a new plant at Conesus for local service.

BUTLER, N. J.—Plans are being prepared by the Borough Council for the installation of an electrically operated pumping unit at the municipal plant.

JERSEY CITY, N. J.—Plans are under consideration by the Downtown Business Men's Association to establish a new ornamental lighting system in lower Broadway.

NEWARK, N. J.—A new company, to manufacture electrical goods, has been organized by C. W. Curtis of Newark, formerly manager of the Splitdorf Electrical Company, 98 Warren Street, and A. B. Chase, formerly factory manager for the same company. The plant of the old Hedenberg Iron Works has been acquired. The present buildings will be demolished and a new plant erected, at a cost of about $1,000,000. The first unit will provide about 130,000 sq. ft. of floor space and will cost about $400,000.

ALLENTOWN, PA.—Plans are being prepared by the Phoenix Silk Manufacturing Company for the construction of a new central power plant to supply light and heat for its two local mills. The company has been granted permission by the City Council to install an underground conduit system between its Adelaide Mill and its ribbon mill in connection with the proposed plant.

BETHLEHEM, PA.—The City Council has authorized an issue of $80,000 in bonds for the installation of a new ornamental street-lighting system.

DUSHORE, PA.—The Sullivan County Electric Company is installing a plant at Dushore. The equipment will include one 125-hp. Keeler boiler, one 100-hp. Hamilton Corliss engine, one 100-kw., three-phase, 60-cycle, 2300-volt generator, switchboard equipment, transformers, etc.; two substations, and 20 miles of transmission lines, of which 15 miles have been erected. Lamps, meters, etc., will be required. N. M. Smith is superintendent. H. L. Troxell is general manager.

GIRARDVILLE, PA. — The Schuylkill Electric Company contemplates the purchase of 500 Westinghouse meters, type 0-A, 5-amp. and 10-amp.

HAMBURG, PA.—The Hamburg Gas & Electric Company is planning to install automatic circuit-restoring devices and three 150-kva. transformers, replacing three 75-kva. transformers; also 25 Cutter 15-amp. street series lamps, replacing 4-amp. metallic-flame arc lamps. A. J. Althouse is superintendent.

PHILADELPHIA, PA.—Large quantities of electrical equipment will be required in connection with the proposed newspaper publication plant of the Philadelphia Public Ledger Company, to be erected at Sixth, Seventh, Chestnut and Ransom Streets, to cost about $5,000,000.

READING, PA.—Plans have been prepared by the Lebanon Steel Company for the construction of a new air-compressor building and substation at its plant.

RINGTOWN, PA. — The Ringtown Electric Light, Heat & Power Company contemplates the purchase of a switchboard, ten transformers (Pittsburgh), 90 meters and overhead-line material. J. A. Yost is manager.

SCRANTON, PA.—Contract has been awarded by the Delaware, Lackawanna & Western Railroad Company for the foundation for the proposed power plant to be located in the vicinity of Nanticoke. Bids, it is understood, will be asked for the proposed plant in the early spring. The cost is estimated at about $75,000.

CHARLESTON, W. VA.—The West Virginia Eagle Coal Company, Union Building, recently incorporated, is planning for the development of extensive coal properties near Boomer. The equipment will include mining machinery, steel monitors, electric motors, etc. J. E. Charlton is treasurer and manager.

WEYER'S CAVE, VA.—The capital stock of the Weyer's Cave Light & Power Company has been increased from $5,000 to $100,000.

WASHINGTON, D. C.—Bids will soon be asked by the Bureau of Yards and Docks, Navy Department, Washington, D. C., for furnishing and installing turbine-driven pumps, feed-water heaters, V-notch meters, filters, forced-draft fan and forced-draft duct, boiler flues, storage tank, extension to coal conveyor, coal chute, coal gate, coal weigher and piping and appurtenances in the boiler plant at the navy yard, Washington, D. C. (Specification 3708). A deposit of $20 will be required for plans and specifications.

North Central States

CLEVELAND, OHIO — The Cleveland Union Terminals Company will begin soon after the first of the year the construction of a union passenger station, to cost about $50,000,000.

DAYTON, OHIO. — Preparations are being made by the Dayton Power & Light Company to double the output of its plant at Miller's Ford on the Great Miami River. Orders, it is understood, have been placed for a 30-000-hp. steam turbo-generator and two large boilers. A second 300-ft. smokestack will be erected. The cost of the proposed work is estimated at about $800,000. O. H. Hutchings is associate general manager.

JACKSON, KY.—Plans are under consideration to consolidate the local plants of the Jackson Light & Power Company and the Kentucky River Light & Power Company in the near future. Improvements, it is understood, will be made to the systems.

FLEMING, KY.—The works of the Elkhorn Coal Corporation at Hemphill on Yount's Fork are being equipped for electrical operation. Transmission lines will be extended from Fleming.

SERGENT, KY.—The installation of an electric light plant in Sergent is under consideration. For further information address Adam Q. Ramey, electrical engineer of the Whitley Elkhorn Coal Company of Sergent.

INDIANAPOLIS, IND. — Contract has been awarded by the O. K. Battery Company for the erection of a second building, 100 ft. by 200 ft. The company will manufacture dry batteries.

INDIANAPOLIS, IND. — The Hatfield Electric Company has been awarded the contract for electrical work in connection with extensions to the plant of the G. & J. Tire Company. The work will include the wiring of two new buildings now being erected, the installation of special switchboards and high-tension work for 33,000 volts, as well as a complete layout for electric motor equipment of the company. The cost is estimated at about $120,000.

SOUTH BEND, IND.—Plans have been announced by the Studebaker Corporation for the erection of 1000 homes, made necessary by the opening of its new automobile plant. A subsidiary company, with a capitalization of $1,000,000, has been formed to carry out the project.

MAHOMET, ILL. — Arrangements are being made for the installation of an electric lighting system in Mahomet. A high-tension transmission line will be erected from Champaign to Mahomet to connect with the plant of the Urbana & Champaign Railway, Gas & Electric Company, which will supply the energy.

CYLON, WIS.—The Cylon-Forest Electric Company, recently organized, is erecting an electric transmission line to connect with the plant of the Apple River Milling Company, from which it will purchase electricity for distribution in Cylon. H. A. Frey of Cylon is president.

GALESVILLE, WIS.—The Davis Mill Company is contemplating changing its electric plant from direct to alternating current during the coming year. B. W. Davis is manager.

LENA, WIS.—The Lena Electric Light & Power Company is contemplating extending its transmission line about 2½ miles next summer. J. N. Bassett is president.

NEW LONDON, WIS.—The city of New London is considering purchasing energy from a new power company, located about 4 miles from the city. If the change is made the present power plant will be converted into a substation. The present multiple street-lighting system is being changed to a series system, and about eighty suburban post lamps are being erected on the main streets. S. B. Dushenski is superintendent.

WAUPACA, WIS.—Preparations are being made by the Little Wolf Power Company for the construction of a dam and power plant on Little Wolf River. L. A. DeGuerre of Grand Rapids, Wis., is engineer. Dr. W. H. Finney of Clintonville is interested in the project.

COHASSET, MINN. — The Minnesota Utilities Company of Chisholm has been granted a franchise to supply electricity in Cohasset. The company is erecting a transmission line from Grand Rapids through Cohasset to Deer River.

ELY, MINN.—Improvements are contemplated to the municipal electric light plant, including the installation of three Heine boilers of 213 hp. and one new condenser. William Mitchell is manager.

LANE, IOWA.—The city of Osawatomie has offered to supply electricity in Lane from its municipal electric plant for a period of twenty years. Bonds to the amount of $15,000 were recently voted for the erection of a transmission line.

MAQUOKETA, IOWA.—The installation of a municipal electric light and power system in Maquoketa is under consideration. E. J. Kullmer is city clerk.

MESERVEY, IOWA.—Bonds to the amount of $93,500 have been voted for the installation of an electric lighting system in Meservey. Energy to operate the system will be supplied by the Iowa Falls Power Company of Iowa City, which will erect the transmission lines.

ST. LOUIS, MO.—The Wood & Lane Company Syndicate Trust Building, St. Louis, it is reported, contemplates the purchase of two 75-kw. to 100-kw., three-phase, 60-cycle, 440-volt belted generators; two 150-kw. to 200-kw., 250-volt direct-current engine-driven generator sets; one 150-kw. to 200-kw., three-phase, 60-cycle, 2300-volt generator and other electrical equipment.

MAYVILLE, N. D.—The City Council is considering extensions to the municipal electric light plant.

MILTON, N. D.—Plans are being prepared for the installation of a municipal electric light plant in Milton. Bids, it is understood, will soon be asked for same.

CHANCELLOR, S. D. — The Hartford (S. D.) Light & Power Company, it is reported, is contemplating extending its transmission lines from Hartford to Chancellor.

Southern States

LEXINGTON, N. C.—Bids will be received by the Mayor and the Board of Town Trustees of Lexington until Jan. 20, 1920, for improvements to waterworks, including construction of pumping station, filter house and filter tubes, auxiliary station, coagulating basin, storage reservoir, 3½ miles of cast-iron pipe line, 3½ miles of 2200-volt transmission line, the installation of motor-driven centrifugal pumps and accessories and filter-plant equipment. Plans and specifications may be obtained at the office of Gilbert C. White, Durham, engineer. J. V. Moffitt is clerk.

MOUNT OLIVE, N. C.—The city of Mount Olive contemplates the installation of two 150-hp. crude-oil engines, directly connected to three-phase, 2300-volt generators, with all necessary equipment, in the municipal electric light plant. Contracts will be placed early in January. T. Eldridge is manager.

GADSDEN, ALA.—A special election will be held Jan. 6 to submit to the voters the proposal to issue $100,000 in bonds to establish a municipal electric light plant. Ernest Smith is city engineer.

FORT SMITH, ARK.—The Fort Smith Light & Traction Company contemplates extensions to its plant to cost about $250,000.

BARTLESVILLE, OKLA. — The Bartlesville Gas & Electric Company contemplates the installation of a 1000-kw. turbine and the erection of two feeder lines. H. F. Stobbart is general superintendent.

DEWAR, OKLA.—A franchise has been granted to the Dewar Electric Company to construct an electric plant to supply electricity in the town of Dewar and for the coal mines.

TAHLEQUAH, OKLA. — The City Council is considering an issue of $100,000 in bonds for the installation of a municipal electric light plant.

ABILENE, TEX.—The Abilene Gas & Electric Company, a subsidiary of the American Public Service Company, plans to take over and rehabilitate the local electric railway system, which has not been operated for some time. About $40,000 will be expended.

ABILENE, TEX.—Work has begun on the construction of the new electric power station of the Abilene Gas & Electric station, to cost about $750,000. The company also contemplates the erection of a system of electric transmission lines from the new plant connecting a number of towns of central west Texas.

DONNA, TEX.—The Donna Light & Ice Company contemplates the installation of additional machinery in electric plant and extensions to ice plant. The company has increased its capital stock from $10,000 to $40,000.

EL CAMPO, TEX.—The Central Service Company is considering the installation of a new Diesel-engine-driven generating unit of about 175 hp. during the coming year. As yet nothing definite has been decided upon. E. B. Noyes is superintendent.

KENEDY, TEX.—The power house of the Kenedy Light & Power Company was recently destroyed by fire.

LOMEYA, TEX.—The Lometa Light & Power Company contemplates the installation of an additional oil engine-driven electric generating unit. M. D. Melear is owner and manager.

MEXIA, TEX.—The Central Texas Ice, Light, Power & Water Company is installing equipment in its new power house and erecting transmission lines to Cooledge, Thornton and Wortham, which will be completed about Jan 1. W. E. Becker is superintendent.

SNYDER, TEX.—The local electric light plant has been purchased by Messrs. Yoder and McCormick of Crowell. The new owners, it is understood, will make improvements to the plant and system, including the installation of new machinery.

Pacific and Mountain States

LANGLEY, WASH. — The Langley Light & Power Company will install a 20-hp. Hallin gas engine and two 1-kva., 2300/110-volt transformers. Phil. Simon is owner and manager.

SEATTLE, WASH. — Extensions are under way at the municipal hydroelectric plant at Cedar Lake and the city steam plant. New equipment will include six 823-hp. Stirling boilers equipped with oil burners, one 12,500-kva. Allis-Chalmers turbine, one 18,000-hp. Pelton turbine and one 350-hp. impulse wheel, two Pelton oil-pressure waterwheel governors, one Westinghouse 12,500-kva., 60-cycle generator, one 12,500-kva. Allis-Chalmers generator, three 5000-kva. Allis-Chalmers transformers, and four 5667-kva. transformers for which bids will be opened Dec. 19. An addition will be erected to both the hydroelectric plant and the city steam plant to provide space for the new unit. J. D. Ross, superintendent of lighting, is in charge of the work.

SHELTON, WASH.—The Shelton Light & Power Company has recently installed a new electric generating unit, consisting of a 20-in. Leffel vertical turbine belted to a 36-kw. three-phase, 60-cycle, 2300-volt generator. About June 1 the company plans to install a 50-kw. generator in its reserve steam plant and also switchboard for same.

WENATCHEE, WASH. — The Public Service Commission has refused to sanction the plan for issuing $80,000 in bonds, to be sold locally, the proceeds to be used in building an additional unit by the Chelan Falls Power Company, the power to be sold to the Wenatchee Valley Gas & Electric Company. The commission takes the stand that the Wenatchee company is capable of financing the installation of additional power units.

SALEM, ORE. — Application has been made to the state engineer by J. K. Romig and J. K. Romig, Jr., for permission to appropriate 25 second-ft. of water from Eagle Creek. It is proposed to develop 700 hp. for mining purposes. The project will include the construction of 2½ miles of pipe line. The cost is estimated at about $300,000.

AVALON, CAL.—The Board of Trustees is contemplating the installation of a 200-kw. generator in the municipal electric light plant. A. B. Waddingham is city engineer.

SAN FRANCISCO, CAL. — The Great Western Power Company is securing rights of way for the erection of a double transmission line from Island Bar to Oakland.

WHITTIER, CAL.—Bids will be received by the Board of Trustees until Jan. 5 for new boilers, pumping engines, electric generators and electrically driven centrifugal pumps for the Water Department. C. L. Trueblood is clerk.

ASHTON, IDAHO.—The Ashton-St. Anthony Power Company has petitioned the Public Utilities Commission for permission to extend its transmission system to the town of Drummond.

RYEGATE, MONT. — The Montana Power Company of Butte is considering extending its transmission lines to Ryegate to supply electricity for lamps and motors here.

Canada

CHATHAM, ONT. — Plans are under consideration by the Public Utilities Commission for extensions to the Chatham Hydro-Electric system, to cost about $90,000. J. S. Jackson is manager.

SHAWINIGAN FALLS, QUE. — Plans have been prepared by the Shawinigan Water & Power Company for the erection of a transmission line.

NOKOMIS, SASK.—A by-law providing for the installation of an electric lighting plant, to cost about $21,000, will be submitted to the ratepayers for approval.

(Issued December 2, 1919)

1,323,332. CONTROL SYSTEM; Norman W. Storer, Pittsburgh, Pa. App. filed Sept. 5, 1916. For series-parallel operation on high-voltage circuit.

1,323,350. SUPPORT FOR ELECTRIC CONTROLLERS; Joel R. Cook, Wilkinsburg, Pa. App. filed Dec. 15, 1916. For motors of small horsepower.

1,323,375. ELECTRIC CONNECTOR; Frederick J. Osius, Racine, Wis. App. filed Oct. 30, 1916. Wires held securely.

1,323,408. OUTLET BOX; Miner Robinson, Newton, Mass. App. filed June 25, 1915. For combined electric and gas fixtures.

1,323,471. PROTECTIVE DEVICE FOR ELECTRICALLY HEATED UTENSILS; Charles J. Heiser, Los Angeles, Cal. App. filed Feb. 13, 1919. Control by conduction of heat from element.

1,323,472. HIGH-FREQUENCY DISCHARGE APPARATUS; William J. Herdman, Toronto, Ont., Can. App. filed Jan. 26, 1918. Intensity and pressure of discharge varied.

1,323,504. ELECTRIC BRANDING DEVICE; Carl D. Turner, Indianapolis, Ind. App. filed March 6, 1918. Prevents unnecessary energy consumption.

1,323,518. MAXIMUM-DEMAND INDICATOR FOR ELECTRIC METERS; Edward M. Ashworth, Toronto, Ont., Can. App. filed May 23, 1918. Determines proper rates of charge.

1,323,525. COOKER; Howard B. Dutton, Denver, Col. App. filed May 16, 1919. Element arranged within a heat-insulating casing.

1,323,556. PROCESS AND APPARATUS FOR PRODUCING ELECTRICALLY WELDED JOINTS; Reuben S. Smith, Milwaukee, Wis. App. filed May 16, 1919. Plates to be welded completely fused.

1,323,576. ELECTRIC FURNACE; William H. Bristol, Waterbury, Conn. App. filed Jan. 14, 1919. Resistance type.

1,323,581. TELEGRAPH AND LAKE SIGNALING SYSTEM; Thomas B. Dixon, New York, N. Y. App. filed July 19, 1915. Uses magnifiers.

1,323,622. SELF-CONTAINED MOTOR AND SPEED CONTROL FOR VIBRATORS; Charles Endorf, Jr., Chicago, Ill. App. filed July 1, 1916. Switch, resistance and motor in compact casing.

1,323,643. ELECTRIC WATER HEATER; Harry A. Mulvany and Harry E. Kennedy, Berkeley, Cal. App. filed Nov. 27, 1918. Applicable to standard boilers.

1,323,747. ELECTROMAGNETISM; Joseph N. Gilbert, Minneapolis, Minn. App. filed April 15, 1915. Magnetism of one polarity only produced by alternating currents.

1,323,751. METAL-HEATING DEVICE; Henry Geisenhoner, Schenectady, N. Y. App. filed April 26, 1918. Rivet heater.

1,323,759. WIRELESS SIGNALING SYSTEM; Alfred N. Goldsmith, New York, N. Y. App. filed Jan. 18, 1917. Tuning by varying one of constants of antenna.

1,323,761. CONSTANT-SPEED DEVICE; Chester I. Hall, Fort Wayne, Ind. App. filed Sept. 19, 1916. For electric time switches.

1,323,768. MEANS TO BE EMPLOYED IN THE ELECTRIC WELDING OF IRON OR STEEL OR ALLOYS THEREOF; Augustus C. Hyde, Perivale, Eng. App. filed July 8, 1919. Wires dipped in flux.

1,323,770. TRANSFORMER; Svend E. Johannesen, Pittsfield, Mass. App. filed Aug. 24, 1916. Changes voltage without varying reactance.

1,323,798. CIRCUIT INTERRUPTER; John F. Tritle, Schenectady, N. Y. App. filed Feb. 1, 1918. Overload trip.

1,323,799. CIRCUIT INTERRUPTER; John F. Tritle, Schenectady, N. Y. App. filed Feb. 1, 1918. Two wiping contacts.

1,323,824. INSTRUMENT FOR DETERMINING CRITICAL TEMPERATURES; Julius R. Brueckner, Wilkinsburg, Pa. App. filed Dec. 30, 1916. Transformer and voltmeter mounted on rod.

1,323,836. METHOD OF REMOVING GASES AND APPARATUS PRODUCED THEREBY; William D. Collidge, Schenectady, N. Y. App. filed Oct 6, 1916. Purification of rare gases.

Record of Electrical Patents

Notes on United States Patents

1,323,860. ELECTRIC-CIRCUIT-CLOSING DEVICE; Arthur J. Hill, Castlemain, Victoria, Australia. App. filed Sept. 19, 1917. Visible float indicator.

1,323,913. ELECTRIC WELDING APPARATUS; Santo Rumolino, Genoa, Italy. App. filed July 26, 1916. Resistance automatically introduced in circuit.

1,323,929. CONTROL SYSTEM FOR ELECTRIC MOTORS; Louis H. Thullen, Philadelphia, Pa. App. filed Jan. 10, 1914. Heavy overloads on alternating-current motors.

1,323,930. SYSTEM OF CONTROL; Louis H. Thullen, New York, N. Y. App. filed Nov. 23, 1915. For friction saws or coal-cutting machines.

1,323,970. BRUSH FOR DYNAMO-ELECTRIC MACHINES; Henry R. Edgecomb, St. Marys, Pa. App. filed Aug. 20, 1917. Pigtail attachment.

1,323,999. ELECTRICALLY HEATED SPRAY VALVE; Hartley O. Baker, Pueblo, Col. App. filed March 13, 1918. Preheats hydrocarbons.

1,324,001. APPARATUS FOR ANNEALING PIPE; Hugh A. Bardeen and Ford W. Harris, Los Angeles, Cal. App. filed April 28, 1917. Polyphase electric furnace.

1,324,002. ELECTRIC HEATER; Robert P. Barnstead, Boston, Mass. App. filed Aug. 4, 1919. Water-tight heater.

(Issued December 9, 1919)

1,324,035. COMBINED ENGINE AND DYNAMO; Mark C. Cosgray, Sandusky, Ohio. App. filed Jan. 30, 1919. Gas-engine-driven dynamo

1,324,051. ELEMENT FOR SINGEING APPARATUS; Theodore F. Hussa, Montclair, N. J. App. filed Jan. 15, 1918. Trough-shaped resistance unit.

1,324,054. ELECTRICAL INSTRUMENT FOR INDICATING INSTANTANEOUS PRESSURES OR CURRENTS; John T. Irwin, London, Eng. App. filed Dec. 7, 1917. Damping oscillograph deflections.

1,324,149. MAGNETIC SEPARATOR; John F. Greenawalt, New York, N. Y. App. filed Jan. 31, 1917. Wet process.

1,324,156. ELECTRIC FURNACE; Felice Jacoviello, Milan, Italy. App. filed Jan. 3, 1919. Complex resistances.

1,324,161. MULTIPLE-UNIT SAFETY SWITCHBOARD; Hubert F. Krantz, Brooklyn, N. Y. App. filed Dec. 26, 1917. Detachable switch units as closed containers.

1,324,177. MEANS FOR AND METHOD OF ATTACHING ELECTRICAL CONDUCTORS TO CONNECTORS, ETC.; Howard B. Sherman, Battle Creek, Mich. App. filed April 11, 1919. Compression-type terminal.

1,324,194. MOTOR-CONTROLLER; Herbert J. Harries, Milwaukee, Wis. App. filed Oct. 12, 1914. Locked independently of master controller.

1,324,204. MAGNETIC GUN; Charles E. Morris, Leavenworth, Kan. App. filed Feb. 23, 1916. Magnetizable object projected by magnetic fields consecutively energized and de-energized.

1,324,226. ELECTRICAL DISTRIBUTION SYSTEM; George A. Burnham, Saugus, Mass. App. filed May 17, 1917. Protects parallel feeders.

1,324,227. WELDING ELECTRODE; Campbell C. Carpenter, Niagara Falls, N. Y. App. filed March 19, 1919. Electrode coating.

1,324,278. CONNECTING DEVICE FOR ELECTRICAL CONDUCTORS; George L. Scheel, Chicago, Ill. App. filed April 11, 1916. Detachable connection for socket.

1,324,279. ELECTRICAL CONNECTION; George L. Scheel, Chicago, Ill. App. filed May 15, 1916. For lamp sockets.

1,324,322. ELECTRIC INSULATOR; Pasquale Raffi, Rome, Italy. App. filed July 9, 1914. Suspension type protected against mechanical breakdown in case of failure.

1,324,334. ELECTRICAL PROTECTIVE DEVICE; Henrik Boving, New York, N. Y. App. filed Aug. 16, 1917. Ground connection protects against abnormal voltage.

1,324,337. METHOD AND APPARATUS FOR CUTTING METAL; Ralph E. Chapman, Brooklyn, N. Y. App. filed June 29, 1918. Cuts metal under water.

1,324,358. CONTROLLER BOARD; David C. Larson, Yonkers, N. Y. App. filed Sept. 16, 1916. Switch panel and resistance elements for elevators.

1,324,401. ELECTRIC CONTROLLING SWITCH; Arthur C. Magrath, Brooklyn, N. Y. App. filed June 29, 1916. Mechanically effects positioning of sequence switch contacts.

1,324,426. STORAGE-BATTERY CONSTRUCTION; Warren P. Loudon, Niagara Falls, N. Y. App. filed April 18, 1918. Escape of electrolyte along conductors prevented.

1,324,449. ELECTRIC SIGNALING SYSTEM; Simon B. Hess, New York, N. Y. App. filed Nov. 27, 1916. Fire alarm.

1,324,522. DRIP-PAN CIRCUIT CLOSER; Frank W. Saltzman, England, Ark. App. filed Aug. 8, 1918. Alarm for refrigerators.

1,324,525. SIGNALING INSTRUMENT; Fredercik George Smith, Sarnia, Ont. Can. App. filed July 12, 1918. Transmission by Hertzian waves over limited distances.

1,324,529. MAGNETIC DRUM SEPARATOR; George Ullrich, Magdeburg, Germany. App. filed Feb. 9, 1916. Uniform magnetic field.

1,324,547. HAND LAMP; Joseph C. Ford, Madison, Wis. App. filed June 6, 1919. Provision against accidental short-circuiting.

1,324,555. SAFETY PANEL BOX; Hubert F. Krantz, Brooklyn, N. Y. App. filed Sept. 6, 1918. Front wall of box readily assembled.

1,324,559. INSULATING SUPPORT; Samuel H. Lanyon, Oakland, Cal. App. filed Oct. 11, 1917. Conveniently assembled.

1,324,573. STOP-CHARGE ELECTRIC REGULATOR; William A. Turbayne, Buffalo, N. Y. App. filed Aug. 15, 1911. Prevents overcharging of storage battery.

1,324,582. METHOD OF MANUFACTURING ELECTRICALLY HEATED DEVICES; William A. Braun, Canal Dover, Ohio. App. filed July 23, 1914. Resistance element embedded.

1,324,657. GRAMOPHONE MOTOR AND THE LIKE; Ira G. Fosler, Chicago, Ill. App. filed June 5, 1917. Direct drive motor.

1,324,707. MANIFOLD HEATER; Vaughan J. Weinberger. Kenmare, N. D. App. filed April 12, 1918. Preheats charge.

1,324,739. TELEPHONE-EXCHANGE SYSTEM; Harvey L. Harris, Rochester, N. Y. App. filed Nov. 15, 1917. Indicates call has been answered.

1,324,742. MULTIPLE RECTIFIER; Oscar M. Leich, Genoa, Ill. App. filed Dec. 28, 1916. For charging storage batteries.

1,324,743. MULTIPLE RECTIFIER; Oscar M. Leich, Genoa, Ill. App. filed Oct. 31, 1918. Operates synchronously vibratory elements.

1,324,749. TELEPHONE SYSTEM; Frank M. Slough, Elyria, Ohio. App. filed May 13, 1915. Interrupting central circuit connections at both ends.

1,324,750. TELEPHONE SWITCHING SYSTEM; Frank M. Slough, Rochester, N. Y. App. filed Aug. 12, 1918. Telephonic interconnection by relays and apparatus.

1,324,751. ELECTRICALLY OPERATED TYPEWRITER; William F. Smith, San Francisco, Cal. App. filed Oct. 17, 1917. Silent-actioned apparatus.

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Our extensive use of such materials has proved of inestimable value to us in determining the compositions which form the best insulation for each individual requirement.

Since we entered into the manufacture of electrical equipment over 30 years ago, the development of our insulating materials has been one of the chief duties of our research engineers.

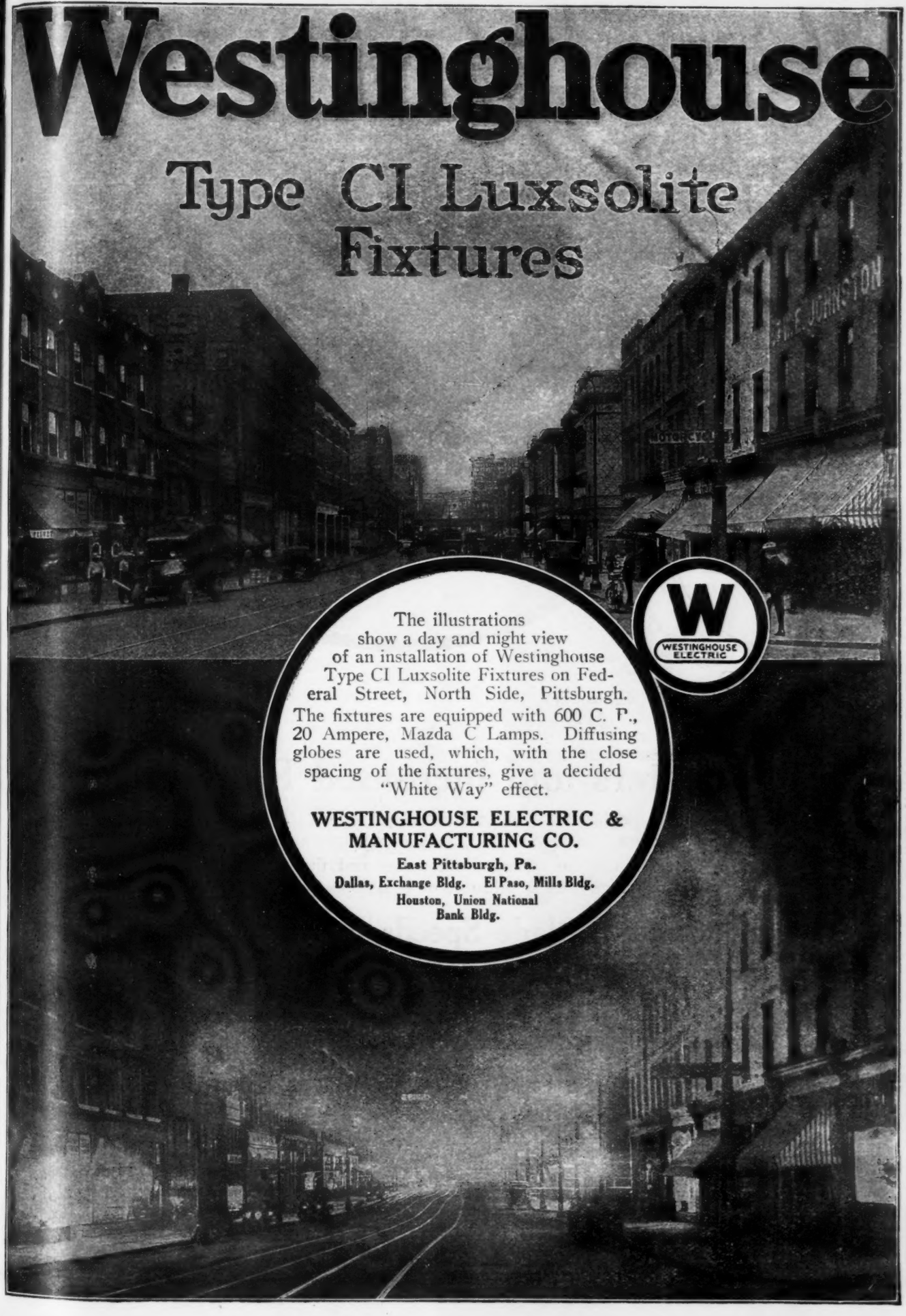
The use of these materials insures continuity of service and therefore lower maintenance costs.

Ask for complete descriptive catalogue 5-A.

Westinghouse Electric & Mfg. Co.
East Pittsburgh, Pa.

Westinghouse

Type CI Luxsolite Fixtures



The illustrations show a day and night view of an installation of Westinghouse Type CI Luxsolite Fixtures on Federal Street, North Side, Pittsburgh. The fixtures are equipped with 600 C. P., 20 Ampere, Mazda C Lamps. Diffusing globes are used, which, with the close spacing of the fixtures, give a decided "White Way" effect.

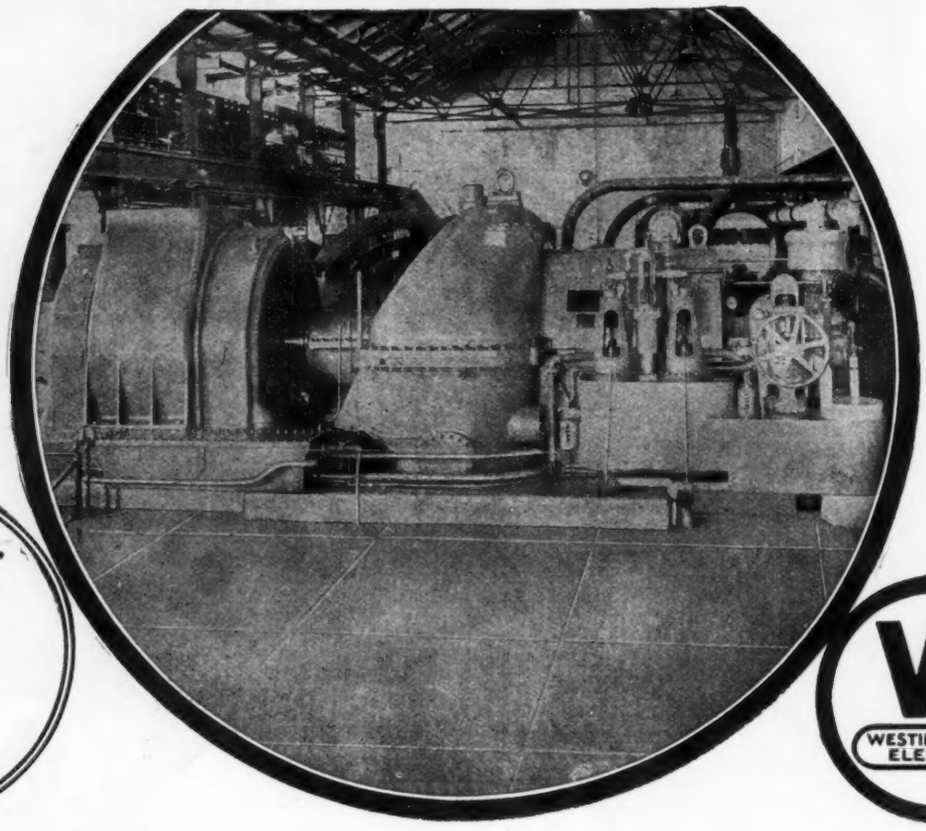
WESTINGHOUSE ELECTRIC & MANUFACTURING CO.

East Pittsburgh, Pa.

Dallas, Exchange Bldg. El Paso, Mills Bldg.

Houston, Union National Bank Bldg.

Reliable, and Why



Feature No. 1

Small Diameters and Increased Reliability

Westinghouse Steam Turbine design permits the use of rotors that are not only rugged in construction, but *small* IN DIAMETER.

From the standpoint of the owner and the operator, the small-diameter Westinghouse rotor is a feature of vital importance, because—

The Low Peripheral Blade Speeds Employed

Westinghouse Steam Turbine design is inherently and readily adaptable to rugged, reliable construction without a sacrifice in operating economy. The purpose of this series is to describe as fully as the limits of the ad will permit, the features which give the Westinghouse Turbine its lasting reliability.

WESTINGHOUSE ELECTRIC & MANUFACTURING CO.
EAST PITTSBURG, PA.

Westinghouse

It's Just the Kind of Lamp We Need

——that's what Mill Engineers say when they are shown the new WESTINGHOUSE MAZDA Mill Type Lamp.

They immediately appreciate their important advantages of using this new lamp in place of the old-style inefficient carbon lamp wherever there is excessive jarring and vibration.

The Mill Type is not only superior to the Carbon lamp in strength—due to two new construction features—but it also produces three times as much light from the same amount of current.

The decided improvement in lighting that results from the substitution of Mill Type Lamps means greater efficiency of the worker, increased production and improved quality of output.

Write for our booklet "The Lamp That Stands the Hard Knocks" and for a description of the new Foot-Candle meter, a unique instrument which tells at a glance whether industrial lighting is up-to-date and efficient or not.

Westinghouse Lamp Co.

165 Broadway, New York City

Sales Offices and Warehouse throughout the Country.
For Canada—
Canadian Westinghouse Co. Ltd.,
Hamilton, Canada.

GUARANTEED BY THE NAME

WESTINGHOUSE MAZDA LAMPS

DIM-A-LITE PORTABLE

FOR THE CHRISTMAS TRADE

Prepare For Christmas Business Today And Count Your Profits Tomorrow

44 DIM-A-LITE PORTABLE

The Wirst Company suggests how you can sell more PORTABLES. We have for distribution among the jobbers and dealers an attractive metal display stand upon which the PORTABLE can be displayed to advantage, either in the show window or on the display counter. An illustration of this display stand appears at the right.

Attractive Christmas folders advertising the DIM-A-LITE PORTABLE are ready for distribution and we would suggest that you get your orders in early for a supply of the same. If you have PORTABLES in stock and would like to have one of the display stands write us today and we will see that you get one.

WIRT COMPANY

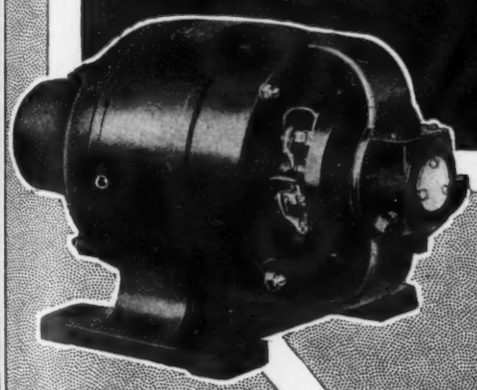
PHILADELPHIA, PENNSYLVANIA

Now is the time to be getting ready for the Christmas trade. Don't wait until the holiday season is at hand before you display your holiday goods. This applies to the jobbers and dealers whether they are selling the DIM-A-LITE PORTABLE or not.

Of the hundreds of thousands of gifts exchanged among friends at Christmas time but few can compare to the DIM-A-LITE PORTABLE, as its utility and attractiveness make it one of the most suitable articles for Christmas giving.

Jobbers and Dealers should know that the profits derived from merchandising the DIM-AA-LITE line and especially the DIM-A-LITE PORTABLE are substantial. Now is the time to get your sales people talking DIM-A-LITE PORTABLE to your customers. It is a practical and useful gift that should appeal to everyone.

DISPLAY STAND FOR PORTABLE



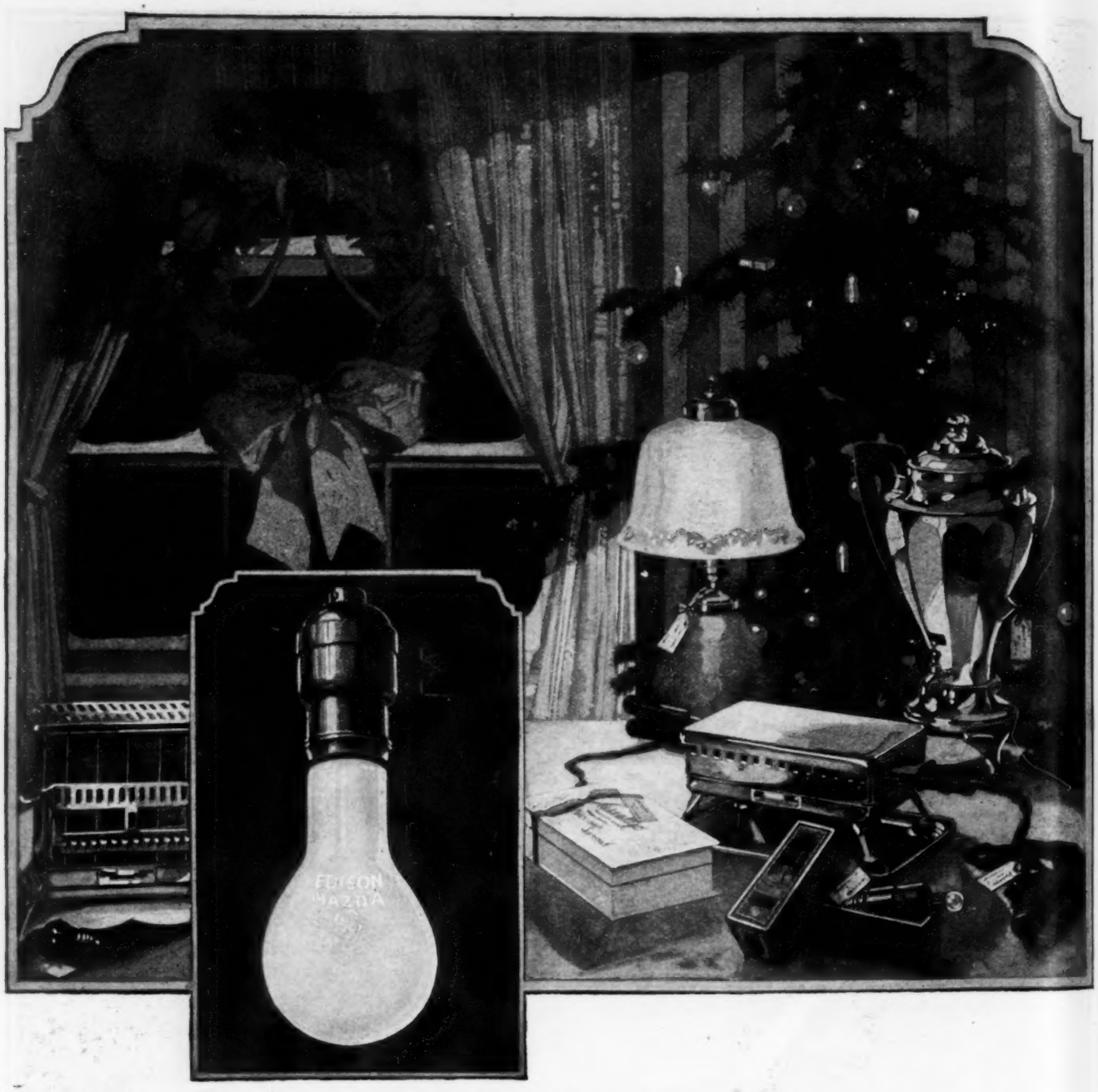
READY TO BACK UP
YOUR SALES EFFORTS

Western Electric Company

INCORPORATED

New York	Philadelphia	Atlanta	St. Louis	Kansas City	Chicago	Denver	San Francisco
Newark	Baltimore	Richmond	Memphis	Minneapolis	Detroit	Salt Lake City	Oakland
Boston	Syracuse	Birmingham	New Orleans	St. Paul	Cleveland	Spokane	Los Angeles
New Haven	Buffalo	Charlotte	Dallas	Duluth	Indianapolis	Omaha	Seattle
Providence	Pittsburgh	Savannah	Houston	Milwaukee	Cincinnati	Oklahoma City	Portland

EQUIPMENT FOR EVERY ELECTRICAL NEED



Pressing the Button for Christmas Profits

MILLIONS of people, including thousands in *your* locality, will get some Christmas shopping ideas from an advertisement like this in the December 20th issue of the Saturday Evening Post—out December 18th.

The dealer who sells Edison MAZDA Lamps is the logical place for customers to look for other electrical merchandise—for these reliable lamps designate the store of quality and service in goods electrical.

* * *

Always look in the Edison Sales Builder for the latest information and service pertaining to Edison MAZDA Lamps.

47D-74

EDISON MAZDA

EDISON LAMP WORKS OF GENERAL ELECTRIC COMPANY

A. C. STARTING SWITCH

TYPE ZB

WITH SAFETY

Push the button to start or stop your small induction motors.

Use the Type Z B Starting Switch and remove the possibility of burns or shocks.

Not only that, but this switch gives protection against starting or running your motors single phase and against overload.

Send for descriptive booklet.

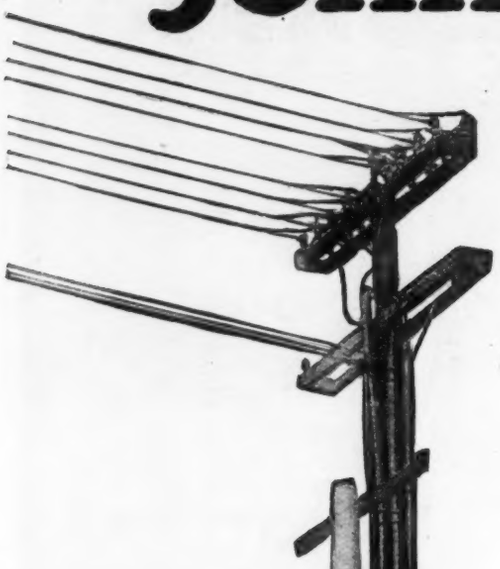
THE ELECTRIC CONTROLLER & MFG. CO.

CLEVELAND, OHIO.

NEW YORK - 50 CHURCH ST.
PITTSBURG - OLIVER BLDG.
BIRMINGHAM - BROWN-MARX BLDG.
SAN FRANCISCO - CALL BLDG.
LOS ANGELES - O. E. THOMAS, WASHINGTON BLDG.
DENVER AND SALT LAKE CITY - O. H. DAVIDSON EQUIPMENT COMPANY
CHICAGO - 53 W. JACKSON BLVD.
DETROIT - DIME BANK BLDG.
TORONTO - TRADERS BANK BLDG.
SEATTLE - 530 1ST. AVE. SOUTH

Johns-Manville
Fibre Conduit

. . —and not only underground



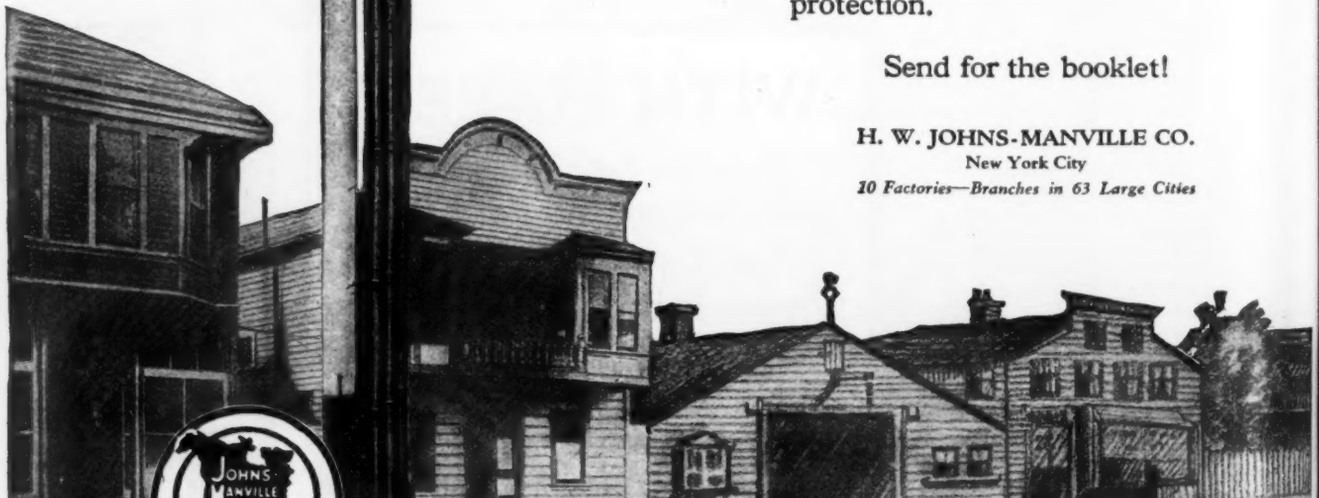
Pacific Light and Power Corporation
Los Angeles, Cal.

BUT up the pole, Johns-Manville Fibre Conduit provides continuous protection. A smooth, double-duty pull-way that tile conduit cannot approach for convenience or economy.

Johns-Manville Fibre Conduit, because of its permanent strength and low ultimate cost, is rapidly growing in favor with engineers who must have adequate cable protection.

Send for the booklet!

H. W. JOHNS-MANVILLE CO.
New York City
10 Factories—Branches in 63 Large Cities



JOHNS-MANVILLE SERVICE COVERS THE CONTINENT

Through—

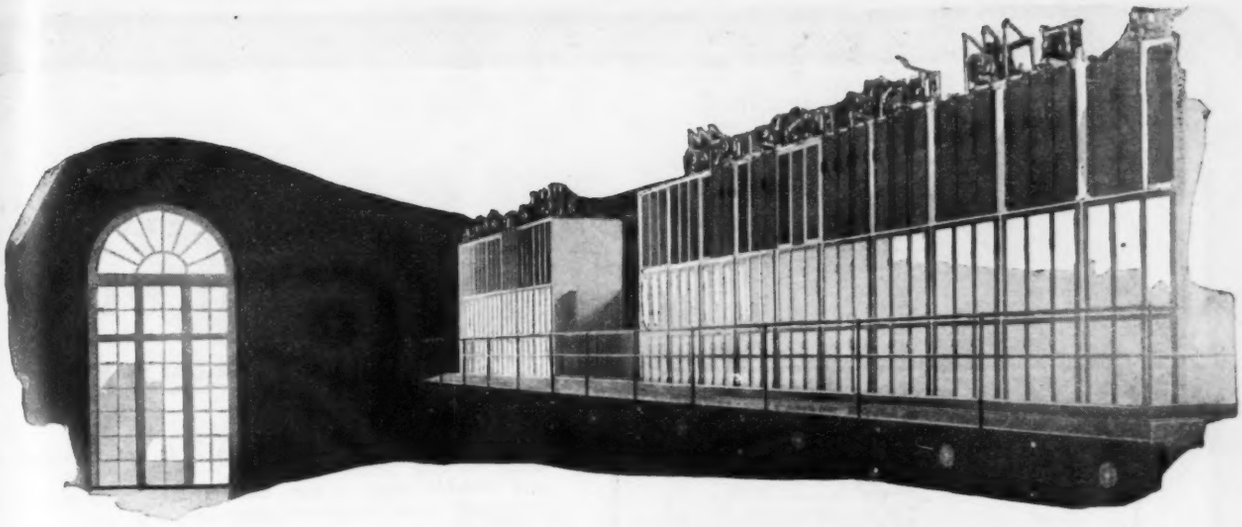
Asbestos

and its allied products

JOHNS-MANVILLE
Serves in Conservation

Heat Insulations, High Temperature Cements, Asbestos Roofings, Packings, Brake Linings, Fire Prevention Products

JOHNS-
Electrical



Johns-Manville Asbestos Wood

All along the line

EBONY Asbestos Wood is making good. A densely, impregnated, heat-resisting structure of great physical and dielectric strength makes it ideal for use in switch boards, panel boards, etc.

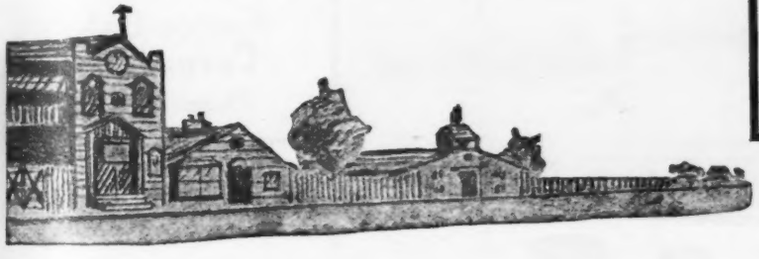
Transite Asbestos Wood is unimpregnated and is peculiarly adapted for use as a fireproof building material to be used instead of wood.

BOTH types of Asbestos Wood may be sawed or bored; they resist warping, are impervious to the elements. Ebony Asbestos Wood or Transite Asbestos Wood can be obtained in any thickness you require.

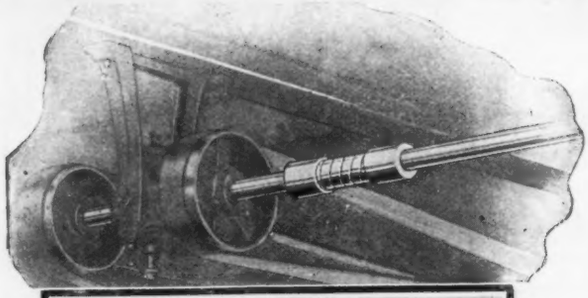
Send to any of our branches for the booklet on Ebony Asbestos Wood (impregnated) or Transite Asbestos Wood (unimpregnated).

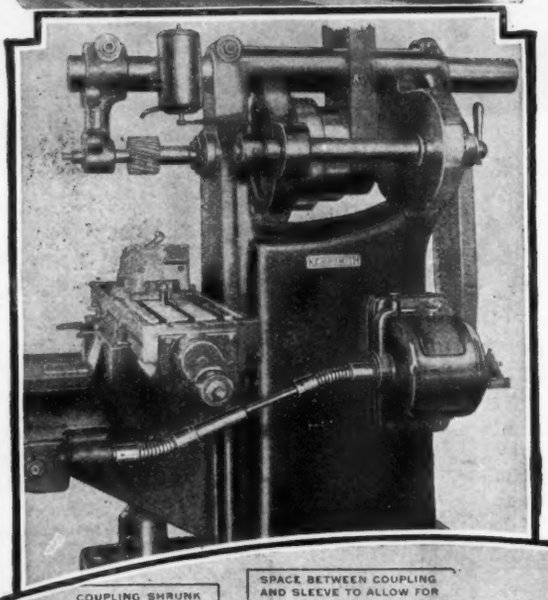
Johns-Manville Service Boxes—

RECOMMENDED for use on either A. C. or D. C. current. They are weather-proof, water-tight and are used as combination cut-outs and switches. For safety and convenience you will find them a very practical piece of equipment.



MANVILLE
Materials





Line Shaft Alignment Unnecessary

With Karge flexible couplings it is not necessary to keep shafting perfectly aligned. Cut out this expense and trouble—one or five inch disalignment makes no difference where Karge couplings are used.

By the use of Karge couplings, power may be carried to odd floor spaces or anywhere at any desired angle.

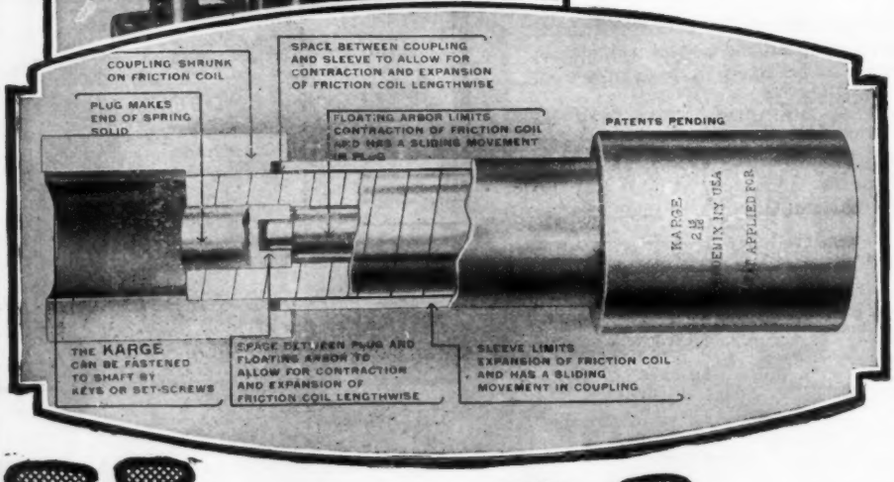
Not only are these couplings of economic value in factory space and labor, but effect a great saving on the machinery itself. By cushioning the starting shocks and evening the power flow, machine life is materially lengthened.

As shown in the sectional drawing the Karge coupling is a form of coil coupling built on the principle of power transmission through friction between discs—the coils forming the discs. This permits bending or disalignment and gives a cushioning effect, which while transmitting full power does it without jar or shock.

These couplings are perfect in operation, noiseless, need no lubrication, are stronger than a solid shaft and last indefinitely.

Investigate Karge couplings as applied to machinery and power shafting. You will find some facts which will be a revelation.

Write us about your problem—information gladly furnished.


COUPLING SHRUNK ON FRICTION COIL
SPACE BETWEEN COUPLING AND SLEEVE TO ALLOW FOR CONTRACTION AND EXPANSION OF FRICTION COIL LENGTHWISE
PLUG MAKES END OF SPRING SOLID
FLOATING ARBOR LIMITS CONTRACTION OF FRICTION COIL AND HAS A SLIDING MOVEMENT IN PLUG
PATENTS PENDING
KARGE
PHOENIX NY USA
PAT APPLIED FOR
THE KARGE CAN BE FASTENED TO SHAFT BY KEYS OR SET-SCREWS
SPACE BETWEEN PLUG AND FLOATING ARBOR TO ALLOW FOR CONTRACTION AND EXPANSION OF FRICTION COIL LENGTHWISE
SLEEVE LIMITS EXPANSION OF FRICTION COIL AND HAS A SLIDING MOVEMENT IN COUPLING

Karge-Baker Corporation
Phoenix, N. Y.

Successors to Three Rivers Machine Tool & Die Co.

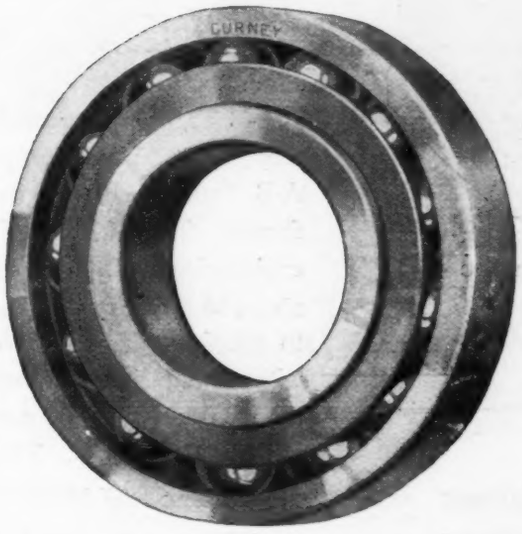
Kargē Flexible Coupling

Cushions the Shock of Starting

GURNEY

BALL BEARINGS

Are a Certainty



Ball Bearings upon which the word GURNEY appears are not an experiment.

They are the result of seventeen years of building ball bearings for every conceivable purpose.

The Pioneering has been done—and the fruits of it are available to all the users of our bearings.

Our Engineering Department, with its wealth of data and experience, is at your service to solve your bearing problems.

GURNEY BALL BEARING CO.

Conrad Patent Licensee

JAMESTOWN, N. Y.

The Transformer with the All-Steel Case

Built for Dependable Service

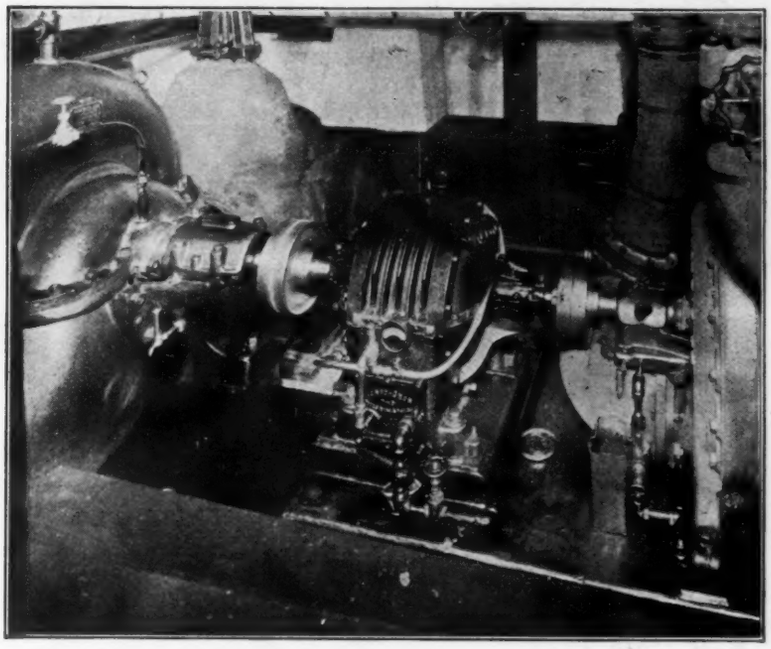
A-B Transformers are built for dependable service—and they give it. Year after year has seen new developments in A-B Transformer design—each resulting in a better transformer. The ***All-Steel Case*** is the latest result of A-B engineering skill. This case, furnished on all transformers above **10 KVA** capacity, reduces the transformer case weight to one-third that of the old cast-iron base and rim—and without reducing its durability and rigid construction. In the new case all joints are welded. The base is reinforced with a steel channel. The great reduction in weight makes installation easier and handling costs less.

A-B Transformers embody all quality features. Their electrical performance is well balanced—high all-day efficiency is the result.

Our years of transformer experience are at your disposal. Can we serve you?

Adams-Bagnall Electric Co.
CLEVELAND, OHIO

AB **Adams-Bagnall**
TRANSFORMERS



Another fact . . . .

The Auxiliary Drive for Traction Power Stations

IN THIS instance the 125 H.P. Turbo Gear is transmitting the power from a Curtis Steam Turbine to a Wheeler condenser pump, with a reduction of 6 to 1.

The fact that there has been no upkeep cost at all is another indication of its universal fitness for driving power plant auxiliaries.

Besides economy of upkeep, its freedom from wear and tear on bearings—there is no side strain—its perfect forced feed, lubrication and its high efficiency of 98% plus, make it the unusually economical gear for this purpose. Will you let our engineers consult with you on your problems? We have a bulletin for you.

The Poole Engineering & Machine Company

Manufacturers of Gears and Power Transmission Machinery Since 1843

Baltimore, Maryland, U. S. A.

General Sales Office: 50 Church St., New York

You Cannot Afford to be Without

The I-C Automatic Compensator

FOR

Starting A. C. Squirrel Cage Induction Motors

It Provides:

1. ***Safety to the Attendant,*** as he operates only a push button remote from the motor and compensator.
2. ***Safety to the motor and machinery driven,*** as the correct time elements acceleration is automatically secure regardless of carelessness or incompetence.
3. ***Increased efficiency and increased production*** because motor is started and stopped at the most convenient and efficient point or points.
4. ***Fewer "holdups" for repairs*** result because the life of the contacts is prolonged by quick and make break of the switches.
5. ***An economical and workmanlike installation*** becouse motor and line connections are very simply made and a great deal of large conduit is saved.

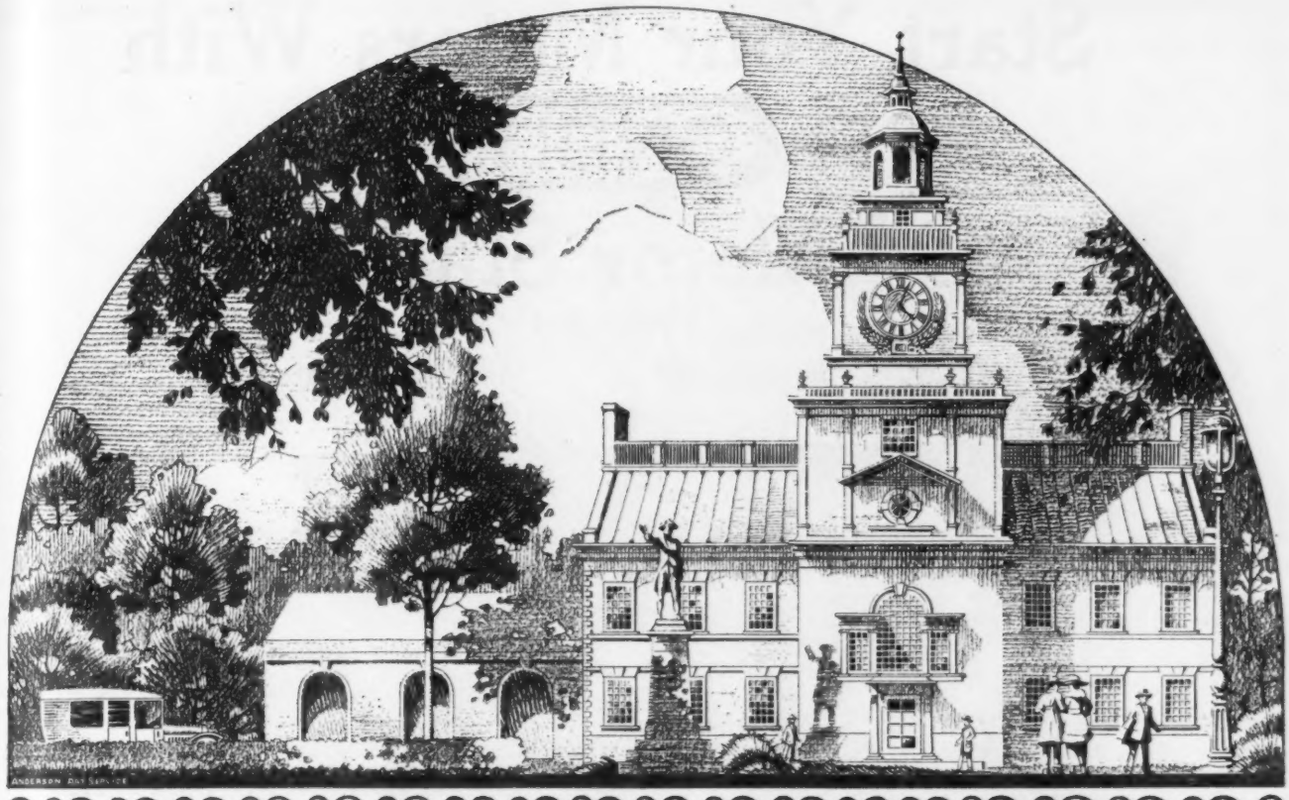
I. C. Automatic Compensators provide all these advantages at a price hardly more than that of the hand operated type

FULLY DESCRIBED IN BULLETIN No. 106

Industrial Controller Co.

MILWAUKEE, WIS.

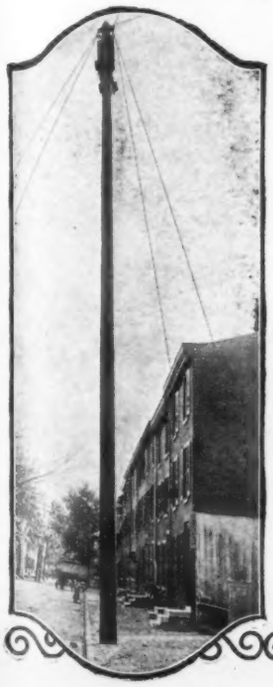
Chicago Detroit | Cleveland New Orleans | Walker Bros. & Haviland Eastern Agents New York Philadelphia | Cincinnati Salt Lake City | Pittsburgh Minneapolis



Western Red Cedar Poles in Ben Franklin's Town

Philadelphia is a long way from the Rocky Mountains, where Western Red Cedar Poles grow, but during the last ten years thousands of these poles have been set in Philadelphia and lines in the surrounding territory. The Keystone Telephone System of Philadelphia was among the first to install

Western Red Cedar Poles



The Keystone engineers selected Western Red Cedar Poles for their long life, strength, and beauty in the line. These poles set in 1901 are still good for many more years' service after being in the line for 18 years.

The Poles Have Done It —
They Have Proved Their Worth

Western Red Cedar Association

PEYTON BUILDING **SPOKANE, WASHINGTON**

These straight, attractive Western Red Cedar Poles were set in 1901 by the Keystone Telephone System of Philadelphia, Pa., for distributing ring service in different parts of the city. They show little wear, and are considered good for 10 years more.

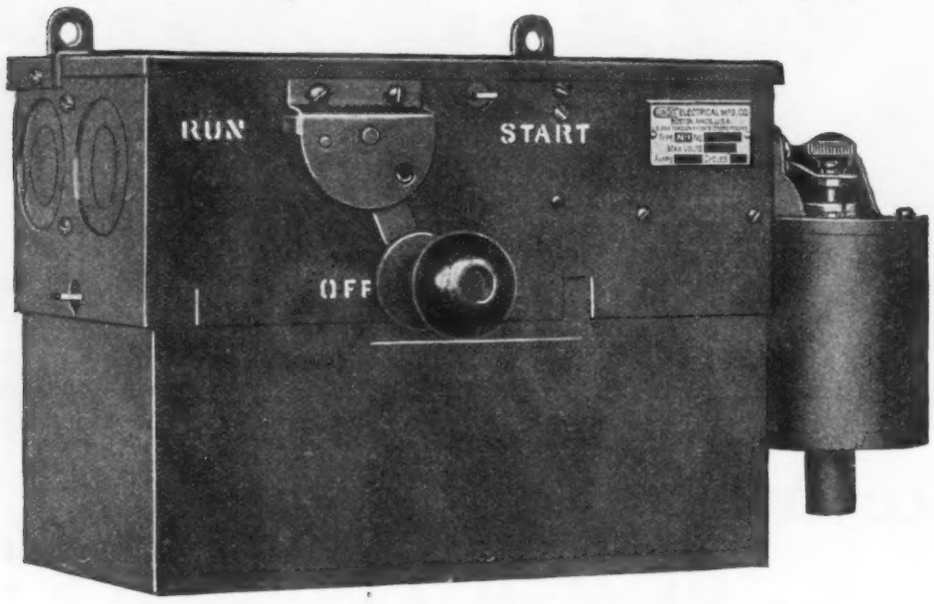
Start Your Motors With

CONDIT

Oil Motor Starters

Type N-1

Maximum Amperes, 30 **Maximum Volts, 600**



New interchangeable reversible "knockout" plates at both ends.

For Single and Polyphase Motors

Starter is furnished complete with series trap coils and time limits. Under voltage attachment may be added if desired.

Application—
Condit Type N-1 Oil Starters are used for starting and controlling single phase and polyphase motors where **absolute electrical protection, safety to operators** and **continuity of service** are of importance.

They are suitable for use with alternating current motors where the full-load current does not exceed 30 amperes at 600 volts or less, provided the momentary starting current does not exceed the following:

110 volts	150	amp.
220 "	125	"
440 "	100	"
550 "	80	"

Operation—
Ball bearing tripping latch makes automatic action positive and easy. Calibration adjustments easily made without tools and locked against tampering with the calibrated setting.

Full details in Bulletin No. 427

Condit Electrical Mfg. Company, South Boston, Mass.

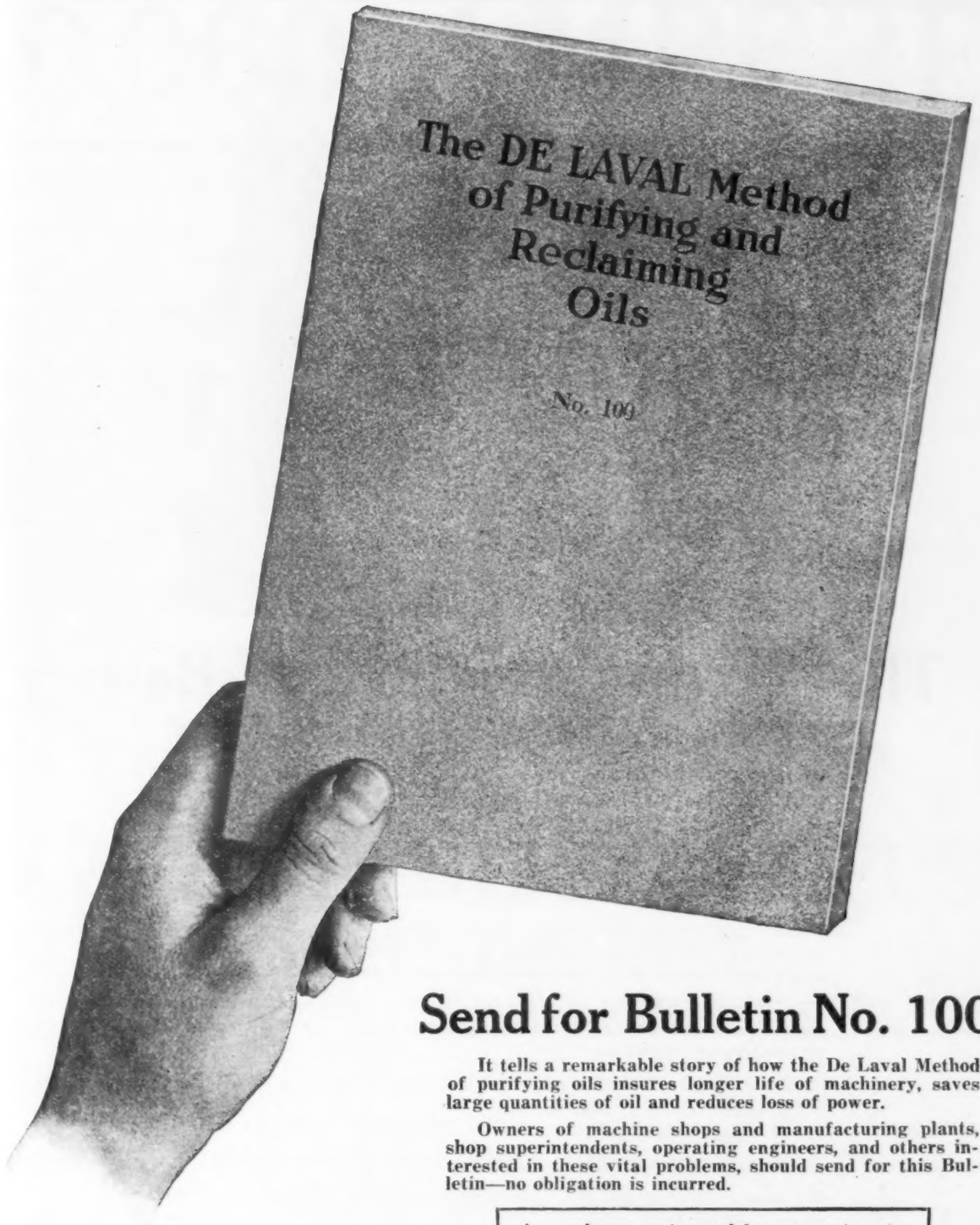
Manufacturers of Electrical Protective Devices

Akron, Ohio, 323 Ohio Bldg.
Albany, N. Y., 467 Broadway
Birmingham, Ala., Brown-Marx Bldg.
Buffalo, 950 Ellicott Sq.
Charlotte, N. C., Commercial Bank Bldg.
Chicago, 19 So. Wells St.
Cincinnati, 1309-10 Union Trust Bldg.
Cleveland, 1202 Illuminating Bldg.
Dallas, 408 So. Ervay St.
Denver, Gas & Electric Bldg.
Detroit, 617 Ford Bldg.
Kansas City, Mo., Interstate Bldg.
Los Angeles, San Fernando Bldg.
Miami, Fla., 329 Thirteenth St.
Minneapolis, 716 McKnight Bldg.
New Orleans, 821 Union St.
New York City, 39 Cortlandt St.
Philadelphia, 929 Chestnut St.
Pittsburgh, Chamber of Commerce Bldg.
Salt Lake City, 914 Boston Bldg.
San Francisco, 583 Howard St.
Seattle, 552 First Ave. S.
St. Louis, La Salle Bldg.
Washington, D. C., Conduit Rd. & Elliott St., N. W.
Youngstown, Ohio, 29 N. Fruit St.

Northern Electric Company
LIMITED

Montreal Winnipeg Halifax Regina Ottawa Calgary Toronto Vancouver London, Ont.

CONDIT: *the Synonym of Safety in Electrical Protective Equipment*



Send for Bulletin No. 100!

It tells a remarkable story of how the De Laval Method of purifying oils insures longer life of machinery, saves large quantities of oil and reduces loss of power.

Owners of machine shops and manufacturing plants, shop superintendents, operating engineers, and others interested in these vital problems, should send for this Bulletin—no obligation is incurred.

A complete experimental department is maintained for working out the problems of our customers by means of centrifugal processes.

THE DE LAVAL SEPARATOR COMPANY

Largest Manufacturers of Centrifugal Machinery in the World

165 Broadway, New York — 29 E. Madison Street, Chicago

DE LAVAL DAIRY SUPPLY CO.
Manufacturers' Selling Agents
SAN FRANCISCO

THE ELECTRIC STORAGE BATTERY CO.

The "Ironclad-Exide" Battery

Is unlike any other storage battery in the world

Pictured above we show one of the tests to which the "Giant" jars—now a feature of all "Ironclad-Exide" batteries—was recently subjected.

This test, as well as others of a more scientific nature, demonstrated conclusively the great strength of "Giant" jars and their ability to "stand up" under the great strains of such operating conditions as exist in Mine Locomotive and Industrial Truck and Tractor service.

"Giant" jars are but *one* feature of the unique construction of the "Ironclad-Exide" battery—there are many others, all combining to make the "Ironclad-Exide" the 100% storage battery for heavy duty work.

The "Ironclad-Exide" battery is the only battery that combines the four essential features necessary in the best possible battery for Vehicle and Locomotive service. These are:

1. Ability to deliver power at heavy discharge rates.
2. High Kilo-watt hour efficiency
3. Long Life.
4. Inherent Ruggedness.

We have recently prepared a booklet entitled "Fifteen Points of 'Ironclad-Exide'" which tells graphically the story of this 100% battery. A copy will be mailed you on request.

THE ELECTRIC STORAGE BATTERY CO.

The largest manufacturer of Storage Batteries in the world

1888 PHILADELPHIA, PA. 1919

New York Boston Chicago Washington Denver San Francisco St. Louis
Cleveland Atlanta Pittsburg Minneapolis Kansas City Detroit Rochester

Special Canadian Representatives Charles E. Goad Engineering Co., 105 Bond Street, Toronto; 40-42 Belmont Park, Montreal

Batteries are made by this Company for every storage battery purpose

THE ELECTRIC STORAGE BATTERY CO.

10,000 AMPERES

The extreme short-circuit test imposed by the Underwriterers Laboratories, Inc., subjects one fuse at a time to full rated voltage at 10,000 amperes.

The New "Jacketed" Expulsion Link

IN

"D & W" RENEWABLE FUSES
MEETS THIS TEST

Full description of D & W Renewable Fuses is contained in Catalogue No. 16 and the facts about the new "Jacketed" Expulsion Links are told in the Supplement to Catalogue No. 16.

Every buyer should have these facts.

D & W Fuse Company
Providence R.I.
U.S.A.

The MAZDA Mill Type Lamp

The regular MAZDA B lamp is rugged enough for almost any factory use. Occasionally, however, excessive vibration or reckless handling has in the past seemed to make necessary the use of old-fashioned carbon lamps in some places. These were hardy, but extremely wasteful of current, and the light was bad. The new NATIONAL MAZDA Mill Type lamp takes their place. It gives three times as much light for the same current; gives better light; and because of its unique construction, will stand a great deal of abuse.

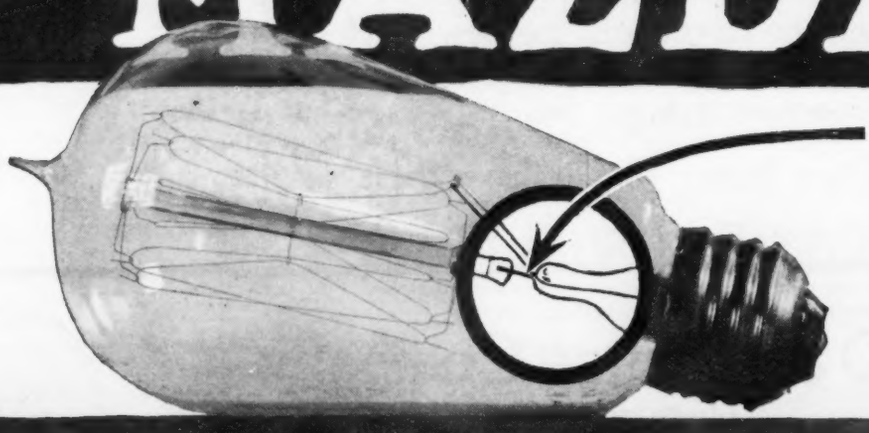
NATIONAL LAMP WORKS

of General Electric Co.

Nela Park Cleveland, Ohio

Each label below represents a sales organization equipped to give a complete lighting service.

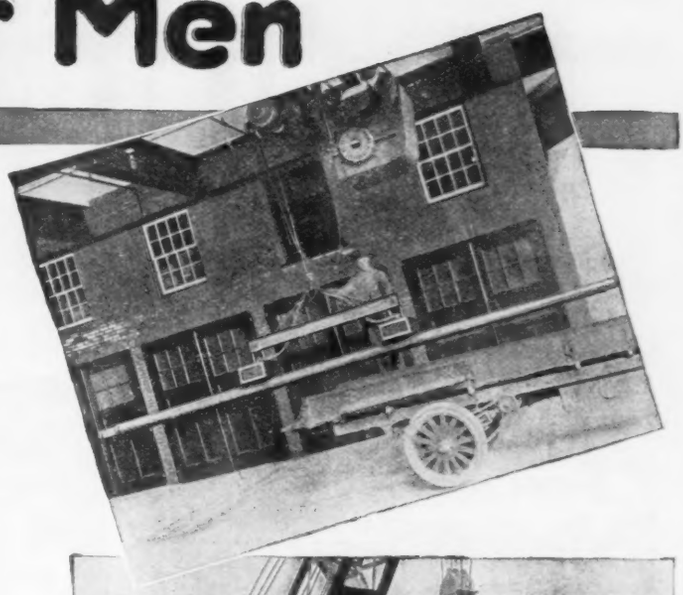
NATIONAL MAZDA



The Piano-Wire Support Takes All the Shocks

Just as the automobile springs take up the road shocks that otherwise would destroy the delicate mechanism of the motor car, ***so this piano-wire spring keeps shocks and vibrations from the lamp filament.*** This MAZDA Mill Type lamp will outlast most carbon lamps in heavy duty service.

Handling More Material With Fewer Men



Raw, Unfinished and Semi-Finished Materials

Cutler-Hammer Lifting Magnets—Circular and Rectangular types—make up for labor shortage.

Movement of materials about the works—loading and unloading can be speeded up and done with fewer men. No chains, grapling hooks or other mechanical means for securing load are required.

Just lower the magnet throw on the current and lift.

Ask any of the following offices for further information.

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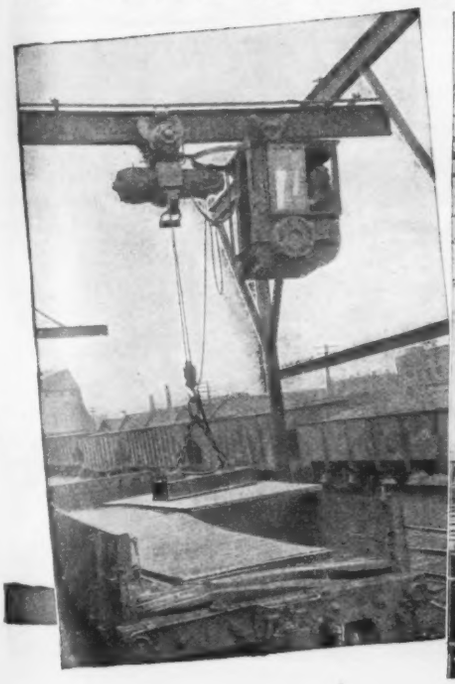
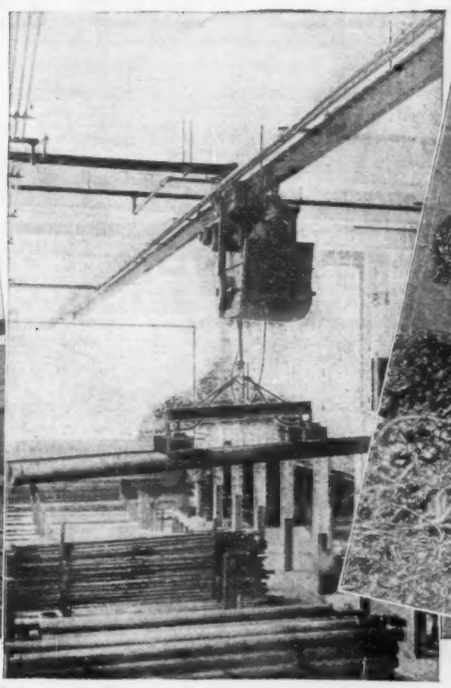
GENERAL MACHINERY CO., Birmingham, Ala.

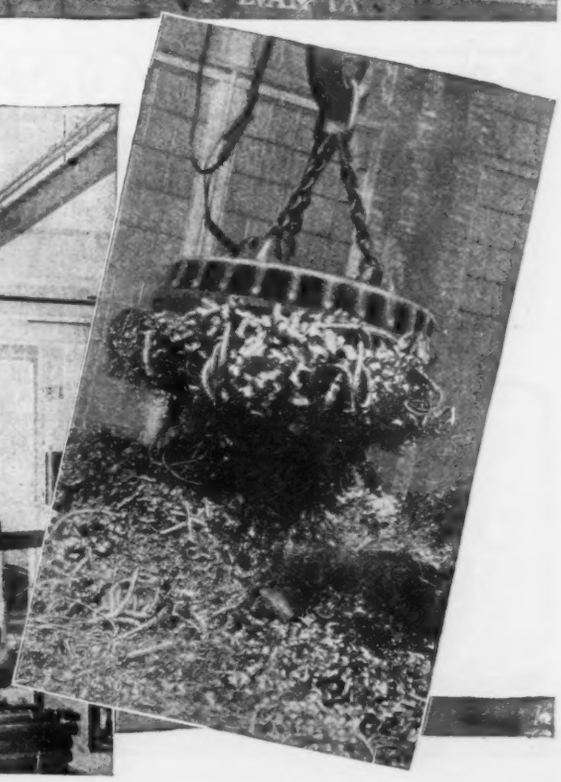
The Cutler-Hammer Mfg. Co.

Works: Milwaukee and New York

LIFTING MAGNETS







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This big, fast selling line of flashlights, hand lamps, and lanterns is one of real profit to dealers. Backed by national advertising and a high standard of manufacture. Many exclusive features that make them popular.

4 Models of Hand Lanterns and Lamps
12 Models of Flashlights
Popular Prices—Big Profits

Write for our complete proposition. Dealers' window displays furnished free.

Dealers, get in touch with this big selling line of Delta Electrical Specialties. Write now, for particulars.

DELTA

Giant Dry Batteries

These are real giants of power. A "no come back" line of quick repeaters and big profit. Widely advertised. Made of finest materials that insure

GREATER POWER
LONGER SHELF LIFE

Order samples of the Giant. Test them—compare them with others. Prove them to be real giants in energy and power.

Delta Electric Company, *Dept. G, Marion, Ind.*

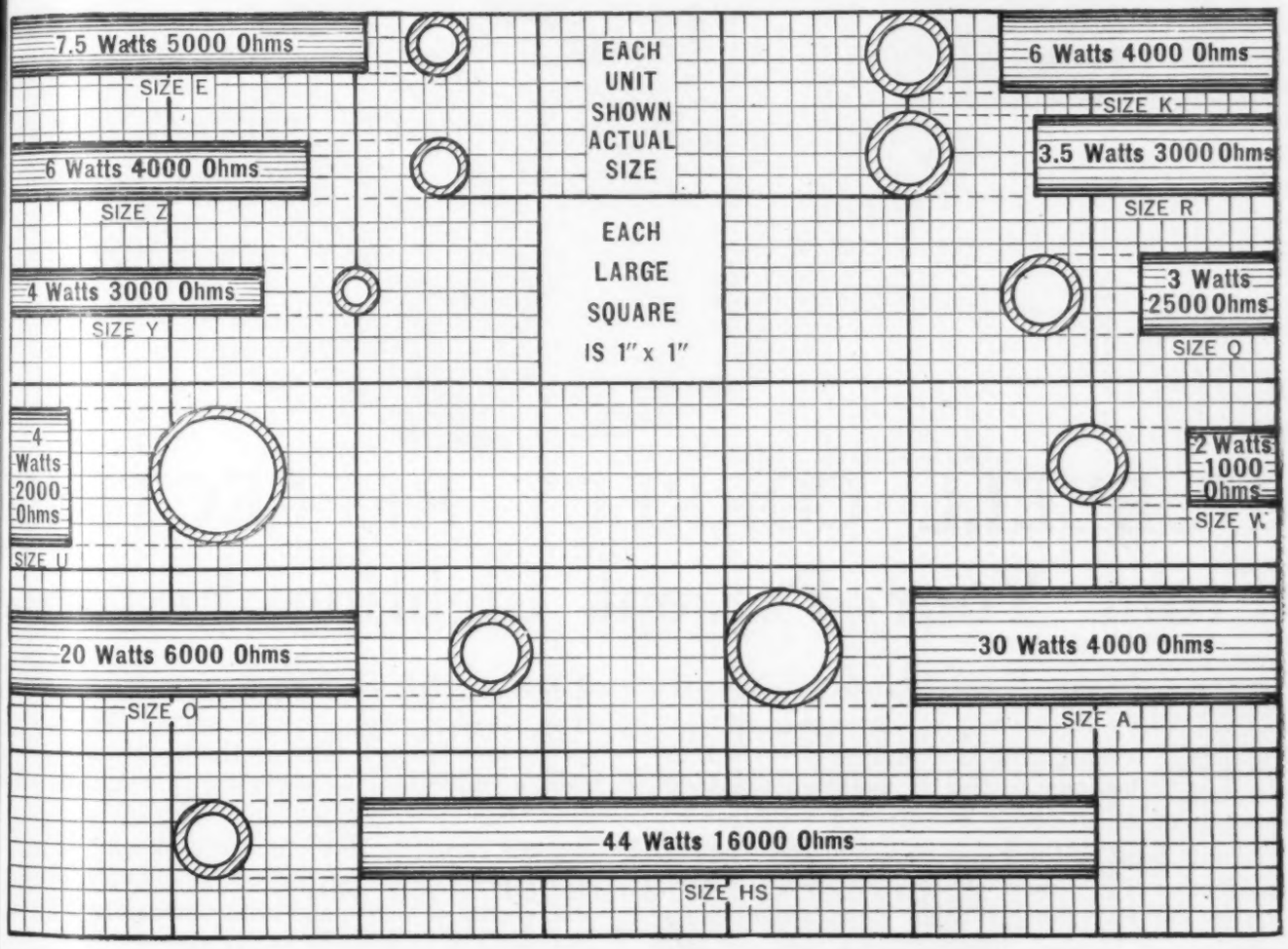
Branches at New York City, Times Building, Times Square **San Francisco, Rialto Building**

World's standard batteries and electric lamps for hand use, bicycles, buggies, etc.

THE GIANT OF ENERGY *is in all* DELTA BATTERIES

Ward Leonard

Any of these values of Vitrohm Resistor Units



Ward Leonard Vitrohm insures permanent value units—permits of highest ohms in given space. Vitrohm, vitreous enamel, completely seals the resistance element against corrosion or atmospheric disintegration.

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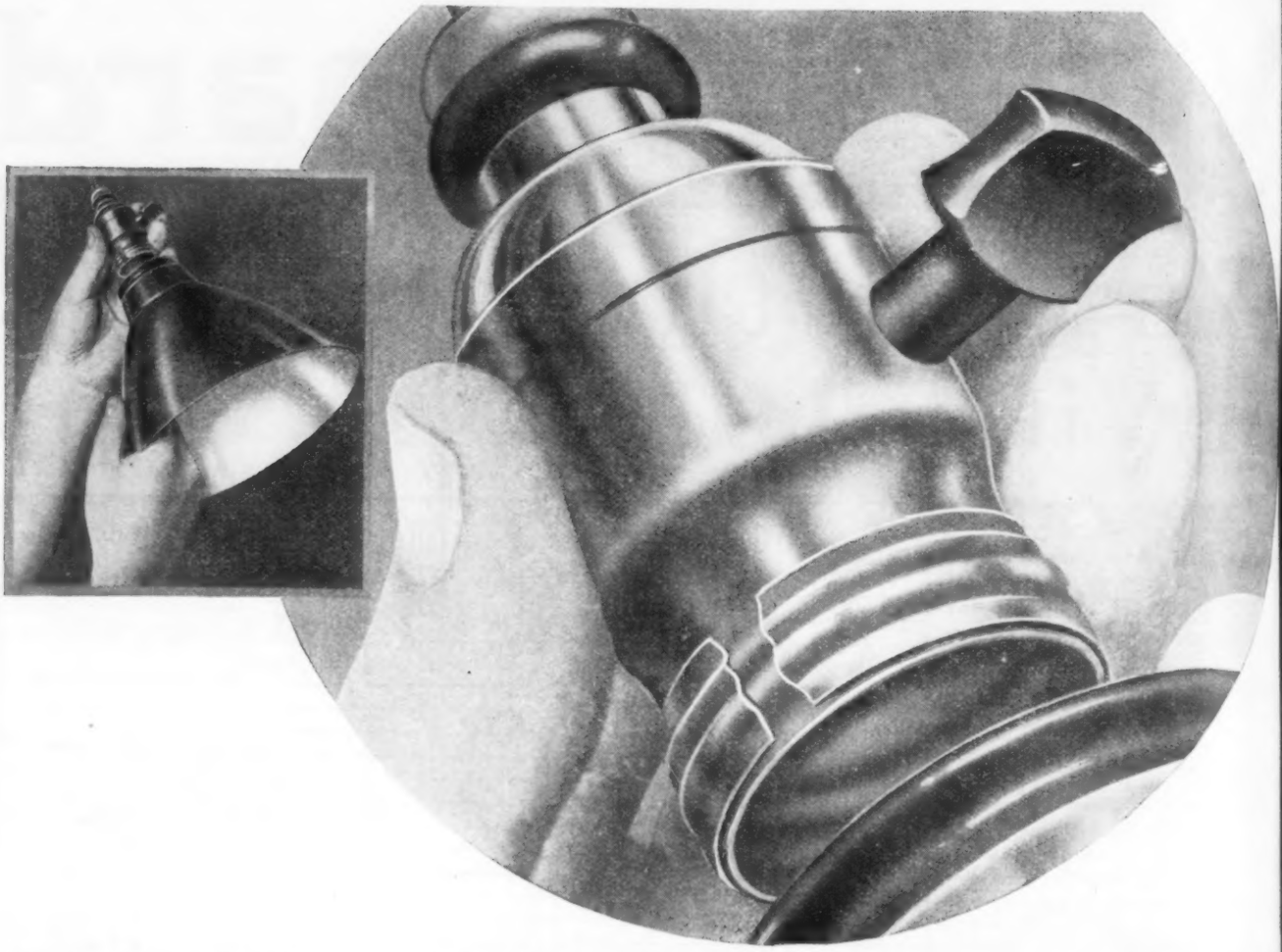

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In your future purchases of enclosed fuses be sure to insist that both the fuses and the renewal links bear the inspection symbol.

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Economy "drop out" renewal links made approval possible for renewable fuses. Millions in use for many years.

Ask for and insist upon Economy renewable fuses and the famous Economy "drop out" renewal links.

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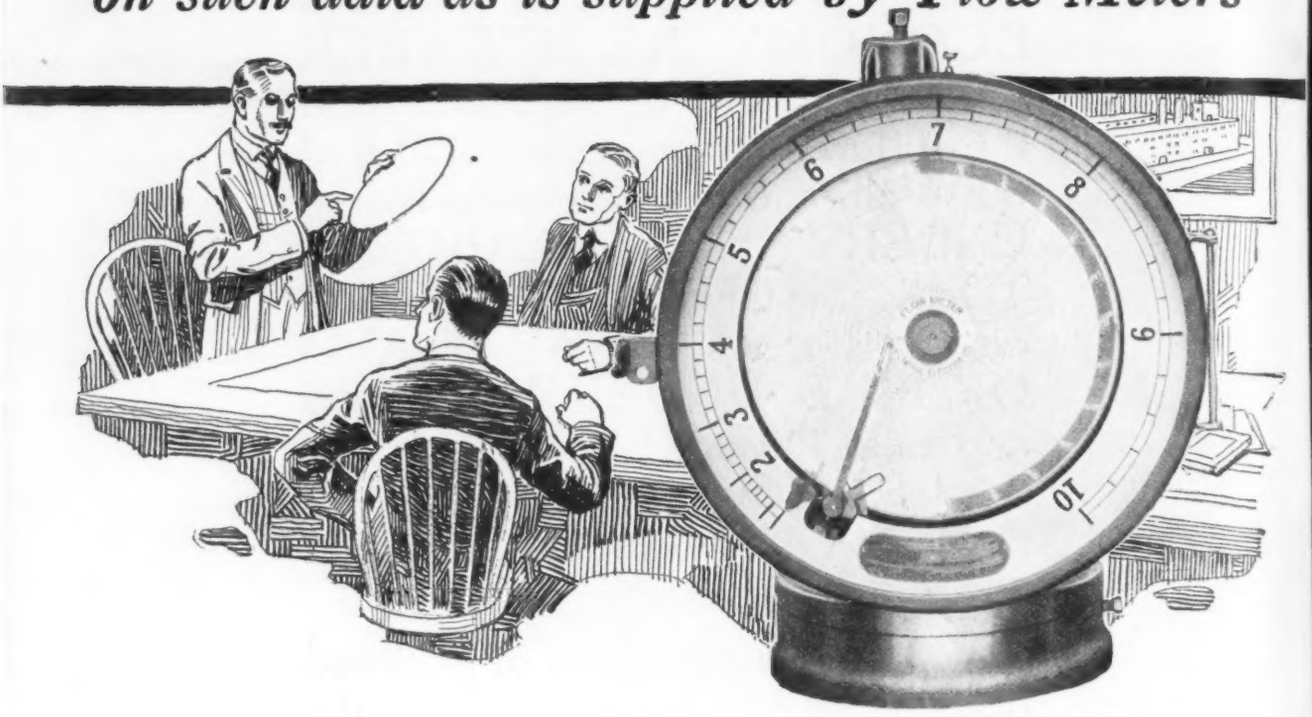
Economy Fuses are also made in Canada at Montreal.

Good boiler operation is necessarily based on such data as is supplied by Flow Meters



G-E Indicating, Recording Flow Meter

"These G-E Flow Meters show us how much steam is generated"

"WE now obtain an accurate measurement of the steam generated and in addition have the satisfaction of knowing that such conditions as bad firing, dirty tubes, incorrect draft, etc., will at once become apparent. These charts show the results the firemen are getting."

The large, legible indicating scale shows the firemen the effects of every adjustment of draft, feed water, etc. Any "loafing" boiler is detected at once and consequently we have materially increased the capacity of our boiler plant.

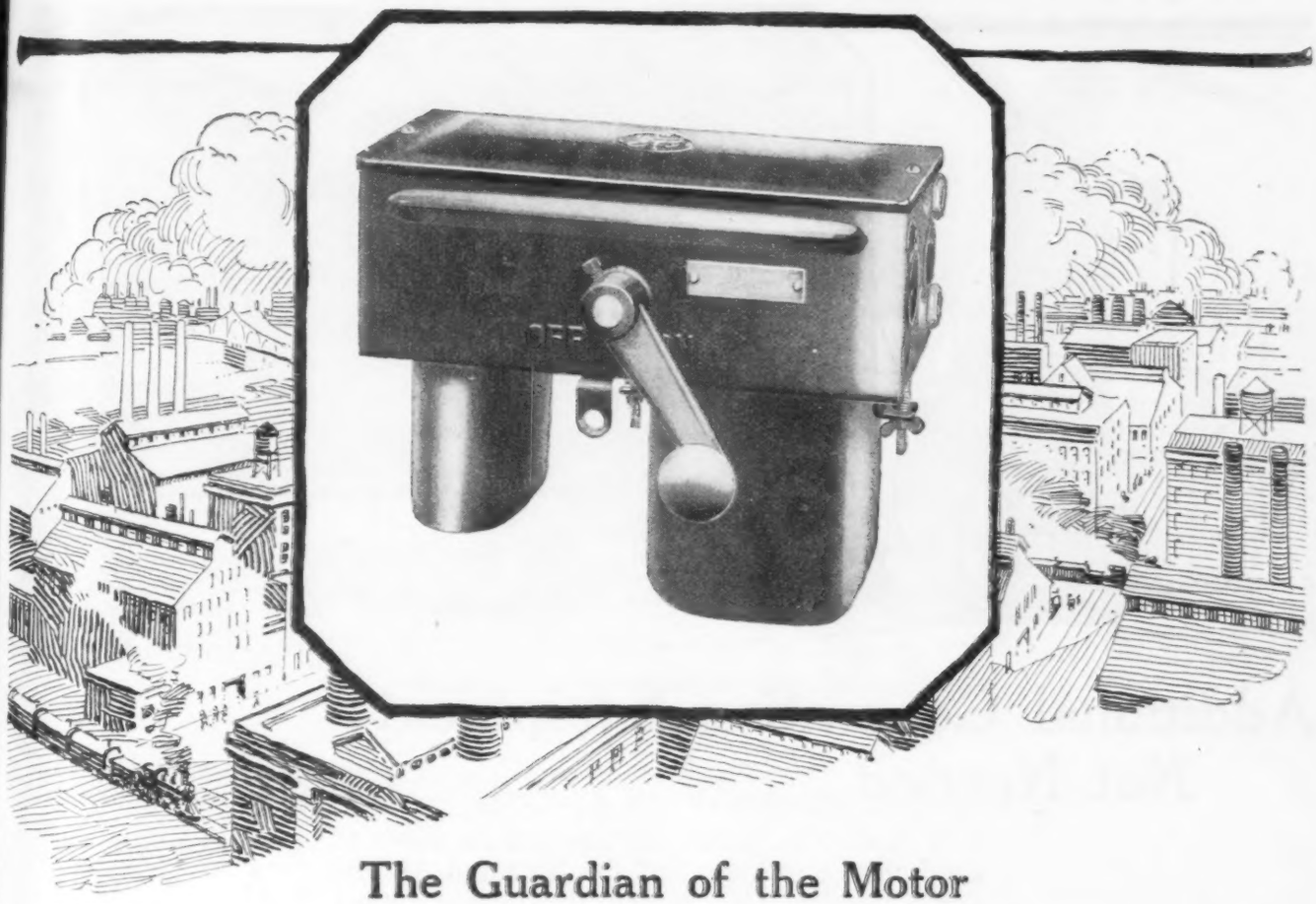
G-E Flow Meters are made for measuring steam, water, gas, oil and air. Write our nearest office for Bulletin 46501B, describing these meters, and the Booklet, "A Guide to Boiler Economy."

General Electric Company

General Office Schenectady, N.Y.

34C-13

THE advantages of electric motors in industry are greater when the proper control and protective devices are installed.



The Guardian of the Motor

FOR starting and controlling small motors put to industrial uses, the Type FP-10 Oil Circuit Breaker is recommended. It is applicable to induction motors *of 25 h. p., 600 volts and less, maximum current capacity not over 50 amperes.*

Complete enclosure of all live parts affords a high degree of personal safety and reduced fire hazard.

In its four different forms, the FP-10 respectively,
—provides for manual opening and closing of the motor circuit,
—provides automatic protection against over-loads,
—provides automatic protection against failures of voltage,
—provides automatic protection against both over-loads and failures of voltage.

The different arrangements of this breaker are described in detail in Bulletin 47419. Write our nearest office.

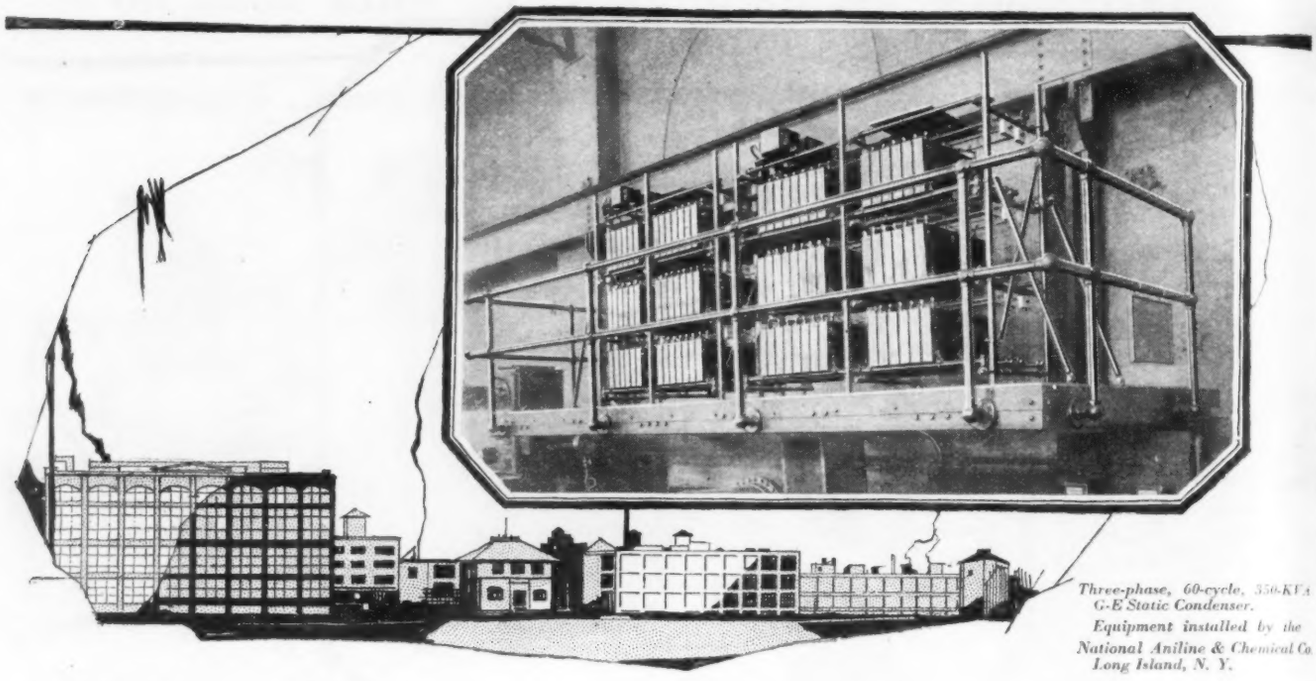
G-E Oil Circuit Breakers

General Electric Company

General Office Schenectady, N.Y.

5A-8

Correction of power factor with static condensers is the simplest and most economical method of reducing idle non-power producing current



Three-phase, 60-cycle, 350-KVA G-E Static Condenser. Equipment installed by the National Aniline & Chemical Co. Long Island, N. Y.

Additional Generating Equipment Not Needed

G-E Static Condenser Equipment installed at the Long Island plant of the National Aniline and Chemical Co., raised the power factor from .65 to .85.

This correction enabled the same generating equipment to carry 24% greater load.

Excitation requirements were reduced 20% and voltage regulation improved.

The need for a new generator, boiler and auxiliary capacity was eliminated.

What is the power factor of your station? Is it as high as it should be?

Perhaps you would like to secure some of the above advantages. Our engineering specialist will investigate if you so desire.

General Electric Company

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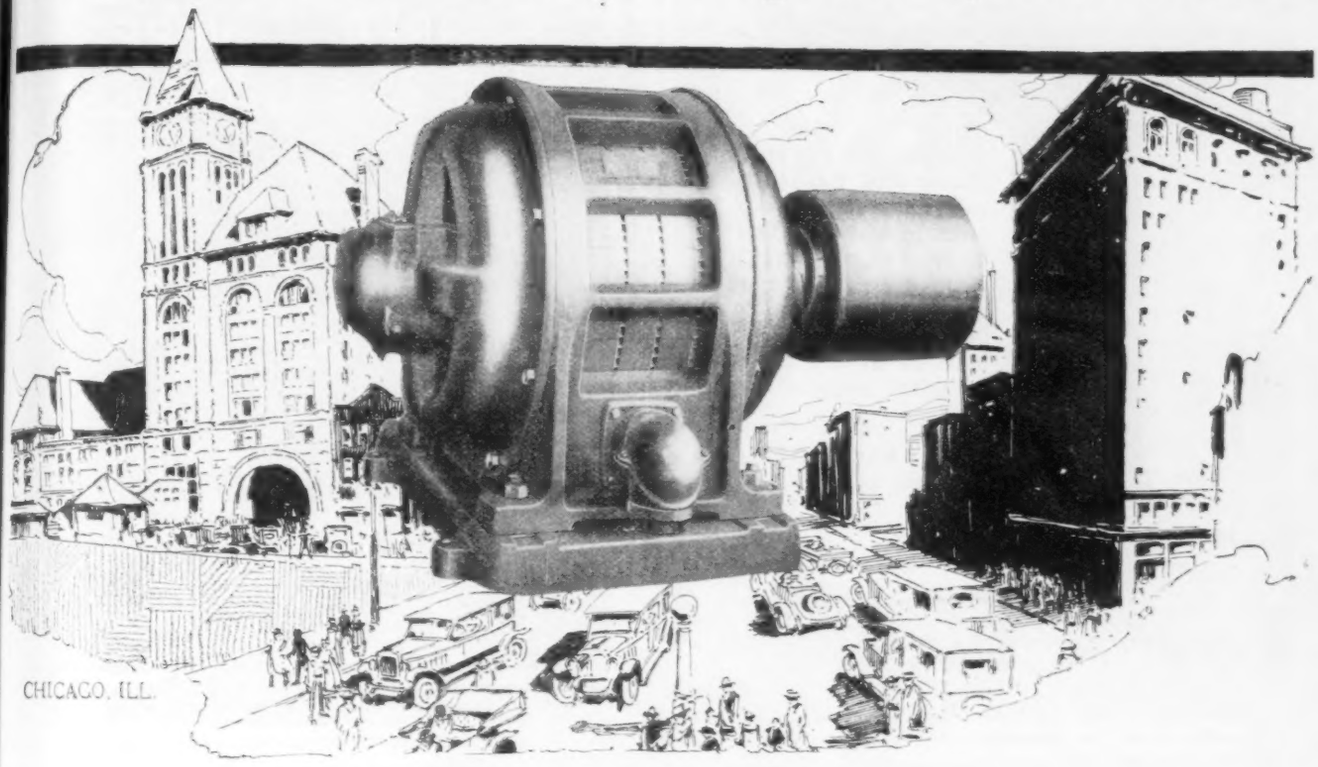
G-E Polyphase Induction Motors are extremely simple and built to withstand hard usage in exposed locations



Durable Motors in Widespread Use ·

ALL over the world you will find G-E polyphase induction motors — more of them than of any other kind.

You will find them in acid fumes on five-year long non-stop runs.

You can find where they have been fished out of fire-swept ruins or flooded mines and quickly put back into operation — where they have operated under water and driven pumps to unwater mines.

Motors in correct sizes and with proper control equipments are available for every industrial requirement. They are stocked in all large cities near the offices of specialists in their application who are at your service.

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43-146

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When you put your money into KERITE you make an investment in service. You do more than buy conductors, insulation and protection. You obtain the best possible combination of the most desirable qualities in permanent form.

KERITE remains long after the price is forgotten.

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Our representatives will be glad to have you call at our Booth, Space 123, at the Atlantic City Convention.

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3

SIMPLEX STEEL TAPED CABLES

Hundreds of towns and cities today use SIMPLEX Steel Taped Cables to distribute current for street lighting. Satisfactory service is assured because the cables are designed for just this type of underground distribution.

Low cost of installation and maintenance make them desirable from an investment standpoint. Streets need not be torn up; pipes, manholes and catch basins need not be moved, and no conduit is required.

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Sturtevant

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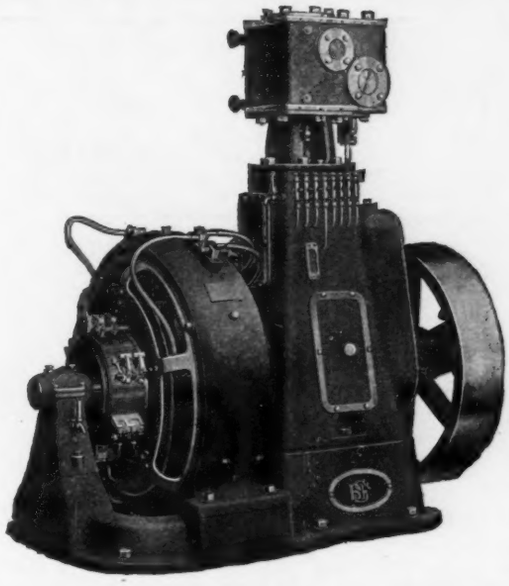
Electric Generating Sets



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—which fact forcibly indorses their efficiency, design, dependability, and quality of construction. Have close regulation and are suitable for all light and power purposes. Specially adapted for isolated power plants, and as auxiliaries in large plants, as well as on shipboard. They are compact, self-contained units, consisting of a Sturtevant steam engine direct connected to a conservatively rated Sturtevant electric generator. Are made with automatic lubricating systems, either gravity or forced feed. All reciprocating parts of the engine are entirely enclosed within the engine frame, which is provided with oil- and dust-proof covers. All parts are readily accessible by removing these covers. Write us for Bulletin No. 239-E which details the merits, design, and construction of Sturtevant Electric Generating Sets.

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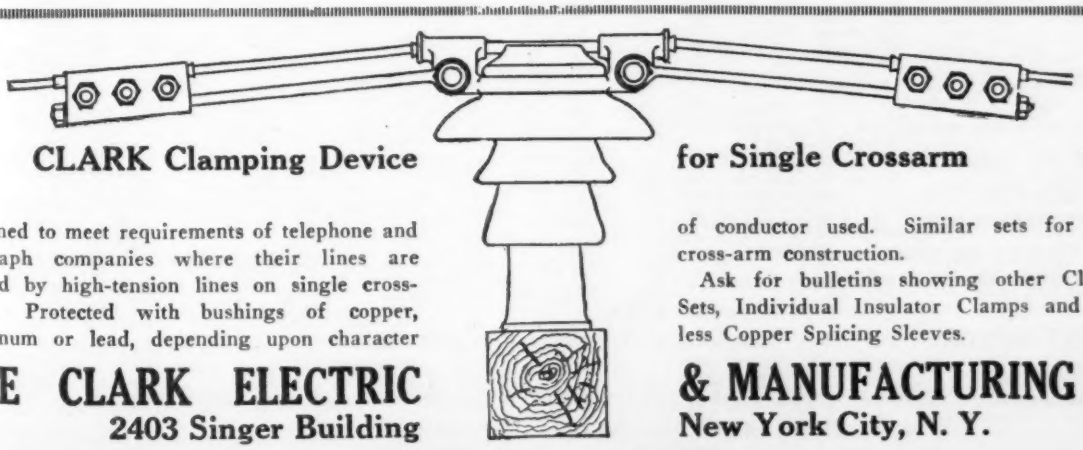

CLARK Clamping Device for Single Crossarm

Designed to meet requirements of telephone and telegraph companies where their lines are crossed by high-tension lines on single cross-arms. Protected with bushings of copper, aluminum or lead, depending upon character of conductor used. Similar sets for double cross-arm construction.

Ask for bulletins showing other Clamping Sets, Individual Insulator Clamps and Seamless Copper Splicing Sleeves.

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It will always pay to "Get it from Gregory."

Send for our "Monthly Bargain Sheet" showing complete stock on hand (revised monthly), with the lowest net prices.

3-PHASE, 60-CYCLE GENERATORS

Kw.		Speed
2— 15	Gen.-Elec., 220 v.	1200
1— 50	Crocker-Wheeler, revolving field, 2300 v.	1200
1— 60	Electric Machinery, revolving field, 2300 v, 2-ph.	1200
1— 60	Electric Machinery, revolving field, 2300 v.	1200
1— 60	Electric Machinery, revolving field, 2300 v.	900
1—200	Western Elec., revolving field, 240 or 480 v.	600
1—200	Western Elec., revolving field, 2200 v.	600

250-VOLT D. C. GENERATORS

Kw.		Speed
1— 7½	Western Elec.	400
1— 20	Sprague, DeLaval single-stage steam turbine, for 150 lbs. steam pressure	2000
1— 30	Western Elec.	1250
1— 30	Westinghouse	725
1— 35	Sprague	750
1— 35	Allis-Chalmers	725
1— 35	Western Elec., Chuse En.	290
1— 45	Westinghouse	650
1— 50	C. & C.	640
1— 56½	Northern	500
1— 60	Keystone, Erie City En.	280
2— 62½	Allis-Chalmers	450
1—100	Allis-Chalmers	850
1—100	Gen Elec	550
2—125	Allis-Chalmers	850
1—150	Ft. Wayne, interpole, 2-bearing	650
1—225	Crocker-Wheeler, 6-pole, 3-bearing	450

MOTORS - GENERATORS, BALANCER SETS, ETC.

Kw.		Speed
2— 6½	Westinghouse, 110-220 v. 3-wire balance set	1125
1— 7½	Hp. Allis-Chalmers, MP, 220 v., d.c. motor, dir. con. to 30 v., 170 amp. d.c. sh. generator with starter, dynamotor	1200
1— 15	Lincoln motor-gen. set, 3-phase, 60 cy., 220 or 440 v. motor, dir con to 10 Kw., (91 amp., 110 v.)	1275
2— 30	Ideal 110-220 v. balancer set	1200
2—150	Gen. Elec. rotary converters, 3-ph., 25 cy., 372 v. a.c. to 600 v., 250 amp., d.c.	750

220-VOLT MOTORS

Hp.		Speed
1— 5	Gen. Elec., type CVC, sh. interpole	1650
1— 5	Robbins & Myers	1040
1— 5	Gibbs	935
1— 5	Crocker-Wheeler	900
1— 6	Westinghouse, var. sp	875-1450
8— 5	Colonial	580
2— 5	General Elec., var. sp	500-1500
1— 6	Western Electric	1600
1— 6	Willey	1275
1— 6	Western Electric	1000
1— 7½	Northern	1450
1— 7½	Browning	1440
1— 7½	Watson	1350
1— 7½	National	975
1— 7½	Allis-Chalmers	875
1— 7½	Westinghouse, comp.	550
2— 7½	Browning	450
1— 7½	Sprague-Lundell, printing press motor	140
1— 10	Northern	1400
1— 10	Westingh., type S, comp	1325
1— 10	Jenney	1060
1— 10	National	850
1— 10	Fairbanks-Morse	700
1— 10	Crocker-Wheeler, variable speed	720-1200
3— 13	Crocker-Wheeler	1100
1— 13	Westinghouse	630
1— 15	General Electric	1750
1— 15	General Electric	1100
2— 15	Browning	900
1— 15	Jenney	850
1— 15	West. Elec., series, crane or hoist motor	700
2— 15	General Electric	650
1— 15	Allis-Chalmers	600
1— 15	Triumph	520
2— 20	Western Electric, crane or hoist motor	700
1— 20	Crocker-Wheeler	500
1— 25	Westinghouse, series crane or hoisting motors	500
1— 20	Westinghouse	400
1— 30	Northern	900
1— 30	Westinghouse	600
2— 30	Westinghouse	575
2— 35	Allis-Chalmers	600
1— 35	Northern	575
1— 35	Westinghouse, series, crane or hoisting motor	500
1— 35	Gen. Elec., type CL, form B, comp., interpole, variable speed	375-850
1— 40	Sprague, interpole, variable speed,	650-900
1— 40	Northern	550
1— 40	National	550
1— 40	Westinghouse	500
1— 45	Holtzer-Cabot	825
1— 45	Allis-Chalmers	650
1— 50	National, MP	750
1— 50	Allis-Chalmers	550
4— 50	Westinghouse	525
1— 50	Westinghouse	450
1— 65	C. & C.	525
1— 75	Allis-Chalmers	850
1— 75	Northern	400
4— 75	Allis-Chalmers	325
1— 90	General Electric, interpole variable speed	300-400
3—150	Allis-Chalmers	650
1—200	Ft. Wayne, 6-pole, comp., interpole	500

2 PHASE 60-CYCLE

Hp.	220 Volts,	Speed
1— ½	Westinghouse	1725
1— ½	Jenney, slip-ring, variable speed	1700
1— ½	Richmond	1120
1— 1½	General Electric	1800
1— 2	General Electric	1800
1— 2	Crocker-Wheeler	1890
1— 2	Kimble, slip-ring, variable speed	1750
1— 2	Triumph	1720
1— 2	Westinghouse	1700
1— 2	General Electric	1200
4— 3	Fairbanks-Morse	1800
1— 3	General Electric	1800
2— 3	Westinghouse	1730
2— 3	Wagner, type BP, 220 v	1720
1— 3	Westinghouse	1130
2— 5	General Electric	1800
3— 5	Wagner	1720
1— 5	Westinghouse	1700
1— 5	Wagner	1140
1— 5	Westinghouse	1130
1— 5	Westinghouse	850
1— 7½	General Electric	1800
2— 7½	Wagner	1730
2— 7½	Western Electric	1720
1— 7½	Richmond	1720
1— 7½	Westinghouse	840
2— 15	Westinghouse	850
1— 15	Westinghouse, type F, slip ring, variable speed	840
1— 20	Westinghouse	580
1— 30	Westinghouse	1720
1— 30	Westinghouse	1120
1— 35	Westinghouse	1750
1— 40	Allis-Chalmers, 220 v.	850
1— 40	Westinghouse	850
1— 75	Fairbanks-Morse	720

3-PHASE, 60 CYCLE A.C. MOTORS

Hp.	220 volts	Speed
2— 5	Wagner	1140
1— 5	Howell	900
1— 7½	Western Electric	1800
5— 7½	Howell	1800
1— 7½	Howell	1200
1— 7½	Lincoln	1200
1— 7½	Westinghouse, type CX	1120
1— 7½	Howell, 440 v., new	900
1— 10	Fairbanks-Morse	1800
1— 10	Western Electric, 220 v.	1800
1— 10	Western Elec., 440 v., new	1800
3— 10	Howell	1800
7— 10	Triumph	1750
2— 10	Westinghouse, type CS, 220 v.	1740
2— 10	Western Electric	1200
1— 10	Howell	1200
1— 10	Lincoln	1200
1— 10	Western Electric	900
1— 10	General Electric, var. sp., slip-ring	600
3— 15	Triumph	1750
1— 15	Western Electric	1200
1— 15	General Electric, type I, form K, vertical, 220 or 440 volts	1200
1— 15	Allis-Chalmers	1150
1— 15	Westinghouse, type CX, 220 v.	1120
1— 15	General Electric, form K, 2200 v.	900
1— 15	Westgh., type CS, 220 v	860
1— 15	Crocker-Wheeler, 220 v	850
1— 15	Westinghouse, type F, slip-ring, variable speed, 220 or 440 v., with Westinghouse drim controller and resistance	840
1— 15	General Electric, form L, (wound rotor) 220 v.	720
1— 15	General Electric, form K, 2200 v.	600
1— 15	Allis-Chalmers, continuous duty, 220 or 440 v., slip-ring, variable speed, with Union Bulletin 7075 penal type controller	600
1— 18	General Electric type ITC form M, slip-ring, (intermittent duty), 220 or 440 v., variable speed with G. E. type TIH reversible drum controller and resistance	670
1— 20	General Electric, type KT, form C, 220 v.	1800
1— 20	Wagner, type BP, Model 11T, 220 v.	1730
1— 20	Fairbanks-Morse, type B, 220 v.	1200
1— 20	Howell, 440 v.	1200
1— 20	Howell, 220 v., new	1200
1— 20	Howell, 440 v. new	1200
1— 20	Gen. Elec., KT, form C, 440 v., new, (40 deg.)	900
1— 20	Howell, 220 v., new	900
1— 20	Howell, 440 v., new	900
1— 20	General Electric, form K, 2200 v.	900
2— 20	Westgh., type CS, 2200 v	870
3— 25	Fairbanks-Morse, type B, 440 v.	1200
1— 25	Westgh., type CS, 2200 v	1165
3— 25	Gen. Elec., type KT, form B, 440 v., new (40 deg.)	900
2— 30	Gen. Elec. Type KT, form B, 220 or 440 v., new (50 deg.)	900
1— 30	Westgh. type CCL., 220 v	840
1— 30	Gen. Elec., form K, 2200 v	720
1— 40	Allis-Chalmers, 2200 v	850
1— 50	Gen. Elec. type I, form K, 220 v.	1200
1— 50	Gen. Elec., type I, form M, 220 or 440 v., slip-ring, constant speed, with panel type starter	1200
1— 50	Gen. Elec., type I, form M, 220 or 440 v., slip-ring, variable speed, with panel type controller	1200
1— 50	Fairbanks-Morse, type B, 220 or 440 v.	900
1— 50	Gen. Elec., type KT, form B, 220 or 440 v., new (40 deg.)	900
1— 50	Gen. Elec., type I, form M, 220 or 440 v., slip-ring, constant speed with starter	900
1— 50	Gen. Elec., type I, form M, 220 or 440 v., slip-ring, variable speed with panel type controller	900
1—50	Westingh., type CS, 220 or 440 v.	870
1— 50	Westing., type CI, slip-ring, intermittent (30 min.) rating, 220 or 440 v., variable speed, with reversible drum-controller and resistance	490
1— 90	Gen. Elec., form L (wound rotor), 220 or 440 v.	900
1—125	Gen. Elec., form K, 220 or 440 v.	720
1—150	Gen. Elec., form L, (wound rotor), 220 or 440 v.	600
2—150	Westinghouse, type CCL, 2200 v.	450

MACHINERY IN STOCK FOR IMMEDIATE SHIPMENT

A.C. STEAM TURBINE UNITS

2 2000 Kw. G. E. horizontal 2- or 3-phase, 60-cycle, 2300-v., 3600 rpm. with condensing equipment.
500 Kw. Westinghouse horizontal 3-phase, 60-cycle, 370-v. (can be rewound for any standard voltage), 3600 rpm. with or without condensing equipment.
500 Kw. G. E. Vertical 3-phase, 60-cycle, 2300-v., 1800 rpm. with or without condensing equipment.
2 100 Kw. G. E. horizontal 3-phase, 60-cycle, 2300-v., 3600 rpm. with or without condenser and pump.

D.C. STEAM TURBINE UNITS

75 Kw. G. E. 150 lb. pressure, 250-v. without rheostat.
15 Kw. Diehl 550-v., 4-pole, 2500 rpm. direct connected to 27 hp. Terry Turbine Rheostat and panel board.
7½ Kw. G. E. 4000 rpm., 250-v., 110 lb. pressure.

DIRECT CONNECTED A.C. UNITS

600 Kw. Can. G. E. 3-phase, 60-cycle, 1200-v., 150 rpm., direct connected to 18 x 36 x 32 Rice & Sargent cross compound engine.
300 Kva. Crocker-Wheeler 3-phase, 60-cycle, 2300v., 164 rpm., direct connected to 20 x 32 Rice & Sargent engine.
210 Kw. G. E. revolving field, 2- or 3-phase, 60-cycle, 2300-v., 200 rpm., direct connected to 20 x 20 Skinner engine.
150 Kva. Ft. Wayne revolving field, 3-phase, 60-cycle, 2300-v., 225 rpm., direct connected to 16 x 16 Erie City engine.
145 Kw. Westinghouse revolving field, 2- or 3-phase, 60-cycle, 2300-v., 276 rpm., direct connected to 14 x 22 x 16 Springfield Id. horiz. engine.

DIRECT CONNECTED D.C. UNITS

300 Kw. Westinghouse 250-v, 240 rpm., E T
125 Kw. Westinghouse 250-v., 280 rpm., direct connected to 14 x 24 x 14 Westinghouse engine.
2 60 Kw. Cro. Wh. 250-v., 275 rpm., direct connected to 13 x 12 Buffalo Forge engine.
60 Kw. G. E. 125-v., 280 rpm., direct connected to 12¼ x 14 Watertown horizontal engine.
37½ Kw. Westinghouse 250-v., 320 rpm., direct connected to 10 x 18 x 10 Westinghouse engine.
35 Kw. Westinghouse 110-v., 310 rpm., direct connected to 11 x 10 Ames center crank engine.
30 Kw. Sturtevant, 125-v., 325 rpm., direct connected to 9 x 9 Sturtevant engine.
30 Kw. Westinghouse Elec. 125-v., 300 rpm., direct connected to 10 x 10 Erie Ball engine.
30 Kw. Westinghouse 110-v., 325 rpm., direct connected to 10 x 10 Harrisburg engine.

BELTED A.C. GENERATORS

250 Kw. Bullock, rev. field, 2- or 3-phase, 60-cycle, 2300-v., 600 rpm.
200 Kw. G. E., 3-phase, 60-cycle, 2300-v., 600 rpm.
1 150 Kva. Westinghouse, 220-440-v., 3-phase, 60-cycle, 900 rpm.
150 Kw. Bullock, 3-phase, 60-cycle, 2300-v., 900 rpm.
115 Kw. Bullock, 2-phase, 60-cycle, 2200-v., 900 rpm.
100 Kw. Allis Chal., 3-phase, 60-cycle, 2300-v., 900 rpm.
60 Kva. Bullock, 2-phase, 60-cycle, 2300-v., 1200 rpm.
50 Kw. Westinghouse rev. field, 3-phase, 60-cycle, 220-v., 1200 rpm.
1 50 Kva. Crocker-Wheeler, 440-v., 3-phase, 60-cycle, 1200 rpm.

MOTOR GENERATOR SETS

150 Kw. Westinghouse, 550-v., 1200 rpm., gen. direct connected to 225-hp. 186 Kva. Westinghouse synch. motor, 3-phase, 60-cycle, 2300-v.
108 Kw. Cro. Wh. type, Secd. 36-v., gen. direct connected to 165-hp. Cro. Wh. 230-v. D. C. motor.
25 Kw. G. E. 230-v., D. C. gen. direct connected to 35-hp. G. E. 3-phase, 60-cycle, 2200-v. motor.

ROTARY CONVERTERS

300 Kw. Westinghouse 3-phase, 370-v. A. C., 575-v. D. C., 600 rpm.
150 Kw. Westinghouse 2- or 3-phase, 185-v. A. C., 250-v., 720 rpm.

FREQUENCY CHANGER SET

600 Kva. Allis - Chalmers 3-phase, 60-cycle, 2300-v., on one end; 3-phase, 25-cycle, 6600-v., on other end.

GASOLINE ENGINE SETS

25 Kw. New G. E. 125-v., 560 rpm., gen. direct connected to 4-cycle 4-cy. G. E. gasoline engine, 43/54-hp., 560 rpm.
10 Kw. G. E. 250/125-v., 3-wire gen., 600 rpm., direct connected to 4-cycle 4-cy., 600 rpm. 16-hp. G. E. gasoline engine.
5 Kw. G. E. 125/250-v., 3-wire, 750 rpm., gen. direct connected to 8/10-hp. 4-cy. G. E. gasoline engine, 750 rpm.
5 Kw. G. E. 120-v., gen. 750 rpm., direct connected to 8/10-hp. 4-cylinder gasoline engine.

3-PHASE, 60-CYCLE MOTORS

1 200-hp. Westinghouse 440-v., 500 rpm., slip ring.
2 200-hp. Westinghouse 440-v., 585 rpm., slip ring.
1 150-hp. Westg. C. W., 440-v., 585 rpm.

ARCHER & BALDWIN, Inc., 114-118 Liberty Street, New York City

TELEPHONE 4337-4338 RECTOR

BARGAINS!—STOCK SHIPMENT

Alternating Current Motors
All New, 3-Phase, 60-Cycle

No.	Hp.	R.p.m.	Volts	Type	Make
7	3	1800	220 or 440	AN	Allis-Chal.
1	3	1200	220 or 440	AN	Allis-Chal.
11	5	1800	220 or 440	AN	Allis-Chal.
10	5	1200	220 or 440	AN	Allis-Chal.
4	7½	1800	220 or 440	AN	Allis-Chal.
3	7½	1200	220 or 440	AN	Allis-Chal.
3	7½	900	220 or 440	AN	Allis-Chal.
11	10	1800	220 or 440	AN	Allis-Chal.
13	10	1200	220 or 440	AN	Allis-Chal.
3	10	900	220 or 440	AN	Allis-Chal.
1	15	1800	220 or 440	AN	Allis-Chal.
4	15	1200	220 or 440	AN	Allis-Chal.
6	15	900	220 or 440	AN	Allis-Chal.
1	20	1800	220 or 440	AN	Allis-Chal.
4	20	1200	220 or 440	AN	Allis-Chal.
3	20	900	220 or 440	AN	Allis-Chal.
1	25	1800	220 or 440	AN	Allis-Chal.
3	25	1200	220 or 440	AN	Allis-Chal.
1	25	900	220 or 440	AN	Allis-Chal.
9	30	1200	220 or 440	AN	Allis-Chal.
6	30	900	220 or 440	AN	Allis-Chal.
3	40	1200	220 or 440	AN	Allis-Chal.
2	50	1200	220 or 440	AN	Allis-Chal.
5	40	900	220 or 440	AN	Allis-Chal.
6	50	900	220 or 440	AN	Allis-Chal.
1	75	1750	220 or 440	CS	Westghse.
1	75	1200	220 or 440	AN	Allis-Chal.
1	75	900	220 or 440	CS	Westghse.
1	75	900	220 or 440	AN	Allis-Chal.
2	75	720	220 or 440	AN	Allis-Chal.
6	100	900	220 or 440	AN	Allis-Chal.
1	100	720	2200	AN	Allis-Chal.
3	100	720	220 or 440	AN	Allis-Chal.
1	100	900	2200	AN	Allis-Chal.
1	150	900	2200	AN	Allis-Chal.
3	150	900	220 or 440	AN	Allis-Chal.
1	150	720	2200	AN	Allis-Chal.
2	150	720	220 or 440	AN	Allis-Chal.
1	200	720	220 or 440	AN	Allis-Chal.

Alternating Current Motors
Slip Ring, 3-Phase, 60-Cycle

No.	Hp.	R.p.m.	Volts	Type	Make
3	30	900	220 or 440	ANY	Allis Chal.
2	50	900	220 or 440	ANY	Allis-Chal.
4	75	900	220 or 440	ANY	Allis-Chal.
2	75	720	220 or 440	ANY	Allis-Chal.
3	100	900	220 or 440	ANY	Allis Chal.
2	100	720	220 or 440	ANY	Allis-Chal.
2	150	900	220 or 440	ANY	Allis-Chal.
3	150	720	220 or 440	ANY	Allis-Chal.
1	150	900	2200	ANY	Allis-Chal.
1	150	720	2200	ANY	Allis-Chal.
3	200	720	2200	ANY	Allis-Chal.

All of the above Slip Ring Motors, complete with drum controllers

Direct Current Motors
All Rebuilt, 230 to 250 Volts

No.	Hp.	R.p.m.	Wdg.	Type	Make
1	½	975	Sh.	MP	Peerless
3	2½	700/900	Sh.	S	Westghse.
1	3	1200	Sh.	MP	Fidelity
1	3	580/1160	Sh.	SA	Westghse.
1	6	750/1500	Sh.	SK	Westghse.
1	10	1180	Cp.	S	Westghse.
3	10	1180	Sh.	S	Westghse.
1	15	1000	Sh.	S	Westghse.
1	15	1000	Cp.	S	Westghse.
1	17½	585	Sh.	A-14	Gibbs
1	20	650	Sh.	MP	Northern
1	20	650	Sh.	MP	Milwaukee
1	20	600	Sh.	MP	W. E.
1	20	900	Sh.	MP	Hobart
1	20	800	Sh.	MP	Imperial
1	20	1025	Cp.	S	Westghse.
1	20	975	Cp.	S	Westghse.
1	25	975	Sh.	MP	Northern
1	36	925	Cp.	S	Westghse.
1	40	675	Sh.	MP	Northwestern
1	40	920	Cp.	MP	Jenny
1	40	800	Sh.	MP	Northern
1	40	700	Sh.	RC	G. E.
1	55	575	Cp.	E6¼A	ORW.E.
1	60	800	Sh.	MP	Northern
1	65	750	Sh.	S	Westghse.
1	75	750	Cp.	M	Westghse.
1	75	850	Cp.	MP	Milwaukee
1	75	700	Cp.	S	Westghse.
1	95	500	Cp.	MP	Jenny
1	105	945	Cp.	DLC	G. E.
2	165	315	Cp.	MP	Northern
1	146	525	Cp.	M	Westghse.

Direct Current Engine Generator Sets
All Rebuilt

1—40 Kw., 230 V., D.C. sh. wd. 725 R.P.M. Milwaukee Generator, belted to 1—Ball Steam Engine, complete.
1—56 Kw. Westinghouse Generator, 250 V., 750 R.P.M., belted to Lord Howler Steam Engine.
1—56 Kw , cp. wd. 250 V., 675 R.P.M. Westinghouse Generator, belted to Westinghouse 3 cylinder Gas Engine.
1—35 Kw., 125 V., 300 R.P.M. Westinghouse Generator, with pedestal bearings, sole plates and shaft for direct coupling.
1—150-kw , 250-V., D.C., cp.wd. Morgan Gardner Generator, direct connected to Atlas steam Engine, complete, all accessories.
1—100-kw., 250-V., D.C. Ft. Wayne Generator, direct connected to Russell Steam Engine, complete, all accessories.
1—60-Kw., 125-volt, D.C., 275-r.p.m., cp.wd. Ridgway Generator, direct connected to 1—Ridgway steam engine, complete with switchboard.
1—75-Kw., 250-volt, D.C., cp.wd. Northern Generator, direct connected to Russell steam engine, complete.

Turbo Generator

1—1250-Kw., 2300-V., 3-ph., 60-cy. Westinghouse Parsons turbo Generator Set, horizontal type, complete.

Locomotive

1—7-ton 250 V DC. Morgan-Gardner 42-in. gage Haulage Locomotive.

Mining Machine

1—CE-7 Sullivan Mining Machine No. 239, Class CY-16-42-in. gage, complete with accessories.

"AMERICA'S BARGAIN HOUSE"

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DUQUESNE ELECTRIC & MANUFACTURING COMPANY

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STEAM ENGINE GENERATOR UNITS

4—Complete Engine Generator Units, each unit consisting of a
60-kw., 120-volt, direct-current Fort Wayne Wood System Generator, direct connected to a Chandler & Taylor horizontal 13 x 13 slide-valve steam engine, operating at 240-r.p.m. on 100 lb. steam pressure.

Included with the above outfits are:

4—Generator Panels, with the usual meter equipment and circuit breakers and switches. All four units are in first-class condition and are available for immediate delivery. The complete outfit is subject to inspection.

MOTORS—SINGLE PHASE, 60-CYCLE

No.	Hp.	Make	Type	Volts	R.p.m.	Avail.
1	2	Wagner	BA	110-220	1750 U	Stock R
1	5	Wagner	BA	110-220	1750 U	Stock
1	5	Wagner	Elev.	220	900 U	Stock
1	5	Wagner	BA		900 U	Stock
1	7½	Wagner	BA	110-220	1200 U	Stock

We also have a large stock of Starters (all capacities) for single-phase motors.
Most of them are New, and are equipped with Undervoltage Release.

MOTORS—2-PHASE, 60-CYCLE, 220-VOLT

No.	Hp.	Make	Type	R.p.m.	Avail.
1	2	G. E	KQ	1200 U	Stock
1	7½	Fidelity	AP	1750 U	Stock
1	10	Westg.	HF	1200 U	Stock
1	75	Westg.	CW	900 N	Stock
1	100	Westg.	CW	900 N	Stock
1	125	Westg.	CCL 3 Brg	450 U	Stock
1	150	Westg.	CCL 3 Brg	514 U	Stock

MOTORS—3-PHASE, 60-CYCLE 220 and 440-VOLT

No.	Hp.	Make	Type	R.p.m.	Avail.
1	7½	Westg.	HF	1200 U	Stock
2	7½	Westg.	CS	1800 N	Stock
1	7½	Westg.	F	900 U	Stock
1	7½	Howell	SC	1200 N	Stock
1	7½	Howell	SC	1200 U	Stock
2	7½	All.-Chal.	AN	1200 N	Stock
1	7½	All.-Chal.	AN EL	900 N	Stock
1	10	All.-Chal.	AN	900 U	Stock
1	10	Westgh.	CX	1200 U	Stock
3	10	All.-Chal.	AN	1200 N	Stock
2	10	All.-Chal.	AN	900 N	Stock
1	10	W. E	KT	1200 N	Stock
2	15	All.-Chal.	AN	1200 N	Stock
1	15	All.-Chal.	AN	900 N	Stock
1	15	All.-Chal.	ANY	1200 N	Stock
1	15	All.-Chal.	ANY	900 N	Stock
2	20	F. M	KBV	1200 U	Stock
3	20	F. M	KBV	1200 N	Stock
1	20	G. E	M	600 U	Stock
2	20	All.-Chal.	ANY	1200 N	Stock
2	20	All.-Chal.	AN	1200 N	Stock
1	20	All.-Chal.	AN	900 N	Stock
1	20	All.-Chal.	ANY	900 N	Stock
1	20	Westgh.	CW	1200 N	Stock
2	25	Westgh.	CS	720 U	Stock
1	25	All.-Chal.	AN	1200 N	Stock
2	25	All.-Chal.	AN	900 N	Stock
1	30	All.-Chal.	AN	1200 N	Stock
1	30	All.-Chal.	AN	900 N	Stock
1	30	All.-Chal.	ANY	1200 N	Stock
1	30	All.-Chal.	ANY	900 N	Stock
1	35	Westgh.	HF	900 U	Stock
2	40	All.-Chal.	AN	1200 N	Stock
2	40	All.-Chal.	ANY	900 N	Stock
2	50	All.-Chal.	AN	720 N	Stock
1	50	All.-Chal.	AN	1200 N	Stock
1	50	All.-Chal.	ANY	900 N	Stock
1	75	All.-Chal.	AN	900 N	Stock
1	75	All.-Chal.	ANY	720 N	Stock
1	100	Westgh.	CS	900 N	Stock
2	150	Westgh.	CW	600 N	Stock
1	150	W. E.	M	600 N	Stock
1	150	Westgh.	CW	720 N	Stock
1	150	Westgh.	CW	900 N	Stock
1	150	Westgh.	HF	600 U	Stock
2	150	Westgh.	CW	600 N	Stock
1	150	Westgh.	CCL 3 Brg	514 U	Stock
2	200	Westgh.	CW	600 N	Stock
1	200	W. E.	M	600 N	Stock
4	200	Westgh.	CW	600 N	Stock
5	200	Westgh.	CW	720 N	Stock
1	275	G. E	I	900 U	Stock

MOTORS—3-PHASE, 60-CYCLE, 2220-VOLT

No.	Hp.	Make	Type	R.p.m.	Avail.
1	75	G. E.	M	514 U	Stock
1	75	All.-Chal.	ANY	720 N	Stock
1	75	Westgh.	CW	900 N	Stock
1	100	Westgh.	CW	900 N	Stock
1	150	W. E	M	600 N	Stock
2	150	Westgh.	CW	600 N	Stock
1	150	Westgh.	HF	600 U	Stock
2	200	Westgh.	CW	600 N	Stok
1	200	W. E.	M 3Brg	600 N	Stock
1	300	G. E.	IL	514 U	Stock

STARTERS FOR SQUIRREL CAGE MOTORS

Starting Compensators, new and used, all Types, Makes and Capacities in stock.

Write us your Requirements

MOTORS—3-PHASE, 60-CYCLE, 550-VOLT

No.	Hp.	Make	Type	R.p.m.	Avail.
6	15	Westgh.	CS	1800 N	Stock
1	75	Westgh.	CW	900 N	Stock
1	100	Westgh.	CW	900 N	Stock
1	125	Westgh.	CCL 3Brg	450 U	Stock
1	150	Westgh.	CCL 3Brg	514 U	Stock
1	150	Westgh.	HF	600 U	Stock
1	150	W. E.	M	600 N	Stock
2	150	Westgh.	CW	600 N	Stock
1	175	Westgh.	CCL 3Brg	600 U	Stock
2	200	Westgh.	CW	600 N	Stock
1	200	W. E.	M 3Brg	600 N	Stock

MOTORS—2-PHASE, 25-CYCLE, 225-VOLT

No.	Hp.	Make	Type	R.p.m.	Avail.
1	50	Westgh.	CCL 3Brg	250 U	Stock
1	50	Westgh.	HF	250 U	Stock
2	50	Westgh.	CW	250 N	Stock
1	50	W. E.	M	250 N	Stock
2	75	Westgh.	CW	250 N	Stock
1	75	W. E.	M	250 N	Stock

MOTORS—3-PHASE, 25-CYCLE, 220 and 440-VOLT

No.	H.p.	Make	Type	R.p.m.	Avail.
1	10	All.-Chal.	AN	750 N	Stock
1	15	All.-Chal.	AN	1500 U	Stock
2	15	All.-Chal.	AN	750 N	Stock
2	20	W. E.	KT	750 N	Stock
1	30	W. E.	KT	750 N	Stock
1	30	All.-Chal.	AN	750 N	Stock
1	30	Westgh.	CW	375 N	Stock
4	40	W. E.	KT	750 N	Stock
2	40	All.-Chal.	AN	750 N	Stock
1	40	Westgh.	CW	375 N	Stock
1	50	Westgh.	CS	750 U	Stock
3	50	All.-Chal.	AN	750 N	Stock
6	50	W. E.	KT	750 N	Stock
1	50	Westgh.	HF	250 U	Stock
2	50	Westgh.	CW	250 N	Stock
1	50	W. E.	M	250 N	Stock
1	60	Westgh.	CCL 3Brg	250 U	Stock
2	75	Westgh.	CW	250 N	Stock
1	75	W. E.	M	250 N	Stock
1	75	W. E.	KT	1500 N	Stock
1	100	W. E.	KT	1500 N	Stock
1	150	W. E.	KT	750 N	Stock
2	150	W. E.	M	750 N	Stock
1	150	W. E.	M	500 N	Stock
1	200	Westgh.	C	500 U	Stock

MOTORS—3-PHASE, 25-CYCLE, 550-VOLT

No.	H.p.	Make	Type	R.p.m.	Avail.
1	30	All.-Chal.	AN	750 N	Stock
1	30	Westgh.	CW	375 N	Stock
1	40	Westgh.	CW	375 N	Stock
1	50	Westgh.	CCL 3Brg	214 U	Stock
1	50	Westgh.	HF	250 U	Stock
2	50	Westgh.	CW	250 N	Stock
1	50	W. E.	M	250 N	Stock
1	75	Westgh.	CW	250 N	Stock
1	75	W. E.	M	250 N	Stock

MOTORS—110-VOLT D. C.

No.	H.p.	Make	Type	R.p.m.	Avail.
5	1-16	R. & M.	Sh	900 U	Stock
1	¼	C. W.	CM Sh	600 U	Stock
1	1	Westgh.	R	1800 U	Stock
1	1	Phoenix	L	450 U	Stock
1	1	G. E.	CQ	950 U	Stock
1	1½	Diehl	G Sh	1180 U	Stock
1	1½	Phoenix	L	450 U	Stock
1	2	W. E.	Cpd	1150 U	Stock
1	2	W. E.	D. F.	850 U	Rented
1	2	Westgh.	SN Sh	1200 U	Stock
1	3	G. E.	CR Sh	700-1125 U	Stock
1	3½	Browning		475 U	Rented
1	3½	G. E.	CQ	775 U	Rented
6	5	Westgh.	SA Sh	1300 U	Stock
2	5	El. Dyn.	Sh	550-1650	Stock
1	5	Westgh.	SK Sh	1100 U	Stock
1	5	C. & C.	Sh	700 U	Stock
1	5	Westgh.	M	625 U	Rented
1	6½	Westgh.	S Cpd	650 U	Stock
1	6	Otis	D	400 U	Stock
1	7½	G. E.	C. E.	550 U	Rented
1	10	Ft. Wayne	Bl	400 U	Rented
1	10	Westgh.	S	650 U	Stock
1	15	R. & M.	Cpd	1050 U	Stock
2	15	Westgh.	SK Sh	1250 U	Stock
1	15	Eddy	G Sh	900 U	Stock
1	15	Wood	L. B.	230 U	Stock
1	20	G. E.	CVC Sh	1720 U	Stock
1	20	Holt Cab.	MP Sh	700 U	Stock
1	20	Holt Cab.	Sh	775 U	Stock
1	20	Westgh.	S	275 U	Stock
1	20	A. C.		300 U	Stock

MOTORS—220-VOLT D. C.

No.	H.p.	Make	Type	R.p.m.	Avail.
1	2	G. E.	CQ	1900 U	Stock
1	3	Phoenix	L Int	900 U	Stock
1	4	W. E.	DF	1700 U	Stock
1	4	Eck	DC	940 U	Stock
1	5	G. E.		1150 N	Stock
1	7½	G. E.	Vr. spd	450-900	Stock
1	7½	Browning	Sh	930 U	Stock
1	7½	G. E.	CA	1525 U	Stock
1	10	Westgh.	M Sh	1250 U	Stock
1	12½	Otis	Elev. Cpd	800 U	Stock
1	15	G. E.	CE Sh	1100 U	Stock
1	20	Ft. Wayne	Elev. Cpd	820 U	Stock
1	20	Westgh	S Sh	1300 U	Stock
1	35	Wood	LB Cpd	465 U	Stock
1	40	Westgh.	S Cpd	550 U	Stock
1	40	All.-Chal.	Cpd	600 U	Stock

MOTORS—550-VOLT D. C.

No.	Hp.	Make	Type	R.p.m.	Avail.
1	10	G. E.	CE	800 U	Stock

GENERATORS D. C.

No.	Kw.	Make	Type	Volts	R.p.m.	Avail.
1	¼	Westgh.	R	125	2100 U	Stock
1	¼	Phoenix	L	110	525 U	Stock
1	¼	G. E.	CQ	110	1100 U	Stock
1	1	Diehl	G	125	1400 U	Stock
1	1.8	F.M.	TR	115	2350 U	Stock
1	1½	Pyoenix	L	110	1050 U	Stock
1	1½	W. E.	DF	110	975 U	Rentd
1	1½	G. E.	CQ	110	2200 U	Stock
1	2½	G. E.	CQ	110	875 U	Stock
1	2½	Browning		110	540 U	Rentd
1	3	W. E.	DF	110	1950 U	Rentd
1	3½	C. & C.		125	800 U	Stock

D. C. TURBINE GENERATOR SETS 125 VOLTS D. C.

No.	Kw.	Make	Type	St. Pres. lb.	Avail.
2	1½	Pyle	Marine	125 N	Stock
2	3	Pyle	Marine	125 N	Stock
1	7½	Westgh.	Marine	85 N	Stock

SWITCHBOARDS FOR TURBO SETS

We can supply immediately a small Switchboard Panel for use with these small Steam Turbine Sets. The Switchboard will consist of:
1—150-volt Voltmeter
2—100 Am. Fuse Receqt.
1—Rheostat
1—150 Amp. Ammeter
1—150 Amp. D. P. S. T. Knife Switch
Stock

TRANSFORMERS

All standard sizes, both 60 and 25-cycle, available for prompt shipment.

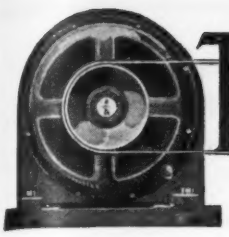
AIR COMPRESSORS AND AIR RECEIVERS

Let us know your requirements, as we have a large stock available.

FREQUENCY CHANGER SET

25-60 Cycles, 4000 Kva. capacity, complete and available for early delivery.

MEETING THE EMERGENCY IS STANDARD PRACTICE



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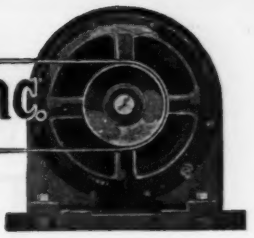

In Stock

MOTOR GENERATOR SETS

1773B—One 75-kw., 120-volt, 690-r.p.m., Crocker-Wheeler, compound wound, direct current Generator coupled by means of flexible coupling to 100-hp. 2200-volt, 3-phase, 60-cycle, Western Electric squirrel cage Motor, complete with field rheostat and starting compensator.....**Immediate**

1870—One 75-kw., 125-volt, 680-r.p.m., Westinghouse, type S, compound wound. D.C. Generator, mounted on sub-base with and direct coupled to 110-hp., 440-volt, 3-phase, 60-cycle Westinghouse squirrel cage motor, complete with field rheostat and starting compensator.....**Immediate**

D.C. DIRECT CONNECTED UNITS

1874—One 60-kw., 125-volt, 280-r.p.m. General Electric, direct current, compound wound Generator, direct connected to 13 x 12 Payne simple center crank engine, complete.....**Immediate**

2095—One 50-kw., 250-volt, 275-r.p.m. Sturtevant, direct current, compound wound Generator, direct connected to 12 x 12 Sturtevant vertical engine.....**1 week**

1956—One 35-kw., 250-volt, 300-r.p.m. General Electric, direct current compound wound Generator, direct connected to a 10 x 10 Harrisburg standard side crank engine.....**Immediate**

DIRECT CONNECTED A.C. UNITS

2156—One 75-kva., 440/220-volt, 257-r.p.m. Westinghouse revolving field, A.C. Generator, with belted exciter and rheostat, direct connected to 13 x 12 Payne simple side crank engine, complete.....**Immediate**

MOTORS—Immediate Shipment F. O. B. New York or Hoboken

Stock No.	Hp.	Volts	Speed	Phase	Cycles	Make and Type
2114	300	2200	450	3	60	Gen. Elec. Slip Ring
2098	300	550	450	3	60	Gen. Elec. Slip Ring
2098A	300	400/220	450	2	60	Gen. Elec. Slip Ring
2032	200	2200	600	3	60	Gen. Elec., Sq. Cage, New
2008	175	2200	575	3	60	General Electric
2166	150	440/220	600	3	60	Westinghouse, Slip Ring
1842	150	440/220	600	3	60	Crocker-Wheeler, Slip Ring
2005	150	2200	575	3	60	Western Electric, Sq. Cage
2006	150	2200	575	3	60	Western Electric, Sq. Cage
1998	125	2200	575	3	60	Western Electric, Sq. Cage
1999	125	2200	575	3	60	Western Electric, Sq. Cage
2025	100	2200	514	3	60	Gen. Elec., Slip Ring
1572A	100	220/440	1200	3	60	Crocker-Wheeler, Sq. Cage
1997	100	2200	695	3	60	Western Electric, 10 days
1773A	100	115	600	DC	DC	Crocker-Wheeler
2158	100	2200	900	3	60	Gen. Elec., Slip Ring, New
2084A	100	115	575	DC	DC	Gen. Elec.
1990	85	2200	720	3	60	Gen. Elec., Form L
1990A	85	440/220	720	3	60	Gen. Elec., Form L
1618	75	220/440	1200	3	60	Gen. Elec., Sq. Cage, New
1573	75	440/220	900	3	60	Crocker-Wheeler, Sq. Cage
1975	75	2200	870	3	60	Western Electric
1976	75	2200	870	3	60	Western Electric
2093	75	115	475	DC	DC	Westinghouse, S
1991	75	2200	900	3	60	Allis-Chalmers, Sq. Cage
1917	65	500	725	DC	DC	Gen. Elec., MP
2122	65	115	575	DC	DC	Crocker-Wheeler
1971	60	2200	695	3	60	Western Electric, 10 days
1972	60	2200	695	3	60	Western Electric, 10 days
1403	50	440/220	720	3	60	Allis-Chal., Sq. Cage
1404	50	440/220	720	3	60	Allis-Chal., Sq. Cage
1572B	50	220/440	600	3	40	Crocker-Wheeler, Sq. Cage
1897	50	550	900	3	60	Gen. Elec., Form L
2159	50	220/440	720	3	60	Gen. Elec., Slip Ring, New
1898	50	220/440	900	2	60	Gen. Elec., Form L
2160	50	440/220	1200	2	60	Gen. Elec., Slip Ring, New
2161	40	220/440	720	3	60	Gen. Elec., Slip Ring, New
2163	40	440/220	720	3	60	Gen. Elec., Slip Ring, New
2106	40	440/220	1200	3	60	Gen. Elec., Slip Ring, New
2107	40	220	1200	2	60	Gen. Elec., Slip Ring, New
2162	40	440/220	1200	2	60	Gen. Elec., Slip Ring, New
1923	35	230	600	DC	DC	Crocker-Wh., Comp. Wound
1921	30	500	625	DC	DC	Allis-Chalmers
2108	30	440/220	1200	3	60	Gen. Elec., Slip Ring, New
2165	30	440/220	1200	3	60	Gen. Elec., Slip Ring, New
2165A	30	220	1200	2	60	Gen. Elec., Slip Ring, New
1922	30	230	550	DC	DC	Allis-Chalmers
1968	30	2200	870	3	60	Western Electric, Sq. Cage
1969	30	2200	870	3	60	Western Electric, Sq. Cage
2142	25	115	750	DC	DC	Crocker-Wheeler
2071	20	500	1125	DC	DC	Gen. Elec.
2144	20	115	800	DC	DC	Gen. Elec., RC, New
2128	20	230	775	DC	DC	Crocker-Wheeler
2129	20	230	775	DC	DC	Crocker-Wheeler
1966	20	2200	1150	3	60	Western Electric
1759	20	220/440	1200	3	60	General Electric, Sq. Cage
2145	15	115	900	DC	DC	Crocker-Wheeler
2127	15	230	1150	DC	DC	Ideal
1762	15	220/440	1200	3	40	General Electric, Sq. Cage
1850A	13	115	875	DC	DC	Westinghouse, S
2103	10	115	650	DC	DC	Gen. Elec., CQ
2118A	10	115	750	DC	DC	Gen. Elec., CE
2141	10	115	650	DC	DC	Gen. Elec., CQ
2126	10	230	1500	DC	DC	Gen. Elec., CQ
2124	10	230	600	DC	DC	Westinghouse, SK
2123	10	230	1150	DC	DC	Gen. Elec., RC
2134	7½	230	875	DC	DC	Crocker-Wheeler
1658	7½	220/440	1800	3	60	Crocker-Wh., Sq. Cage
2131	5	230	960	DC	DC	Crocker-Wheeler
2132	5	230	960	DC	DC	Crocker-Wheeler
2135	5	230	700	DC	DC	Gen. Elec., CE

BELTED D.C. GENERATORS

2084—One 80-kw., 125-volt, 660-r.p.m. General Electric, type MP, compound Generator, complete with base, pulley and rheostat.....**Immediate**

1773—One 75-kw., 125-volt, 700-r.p.m., direct current, compound wound Crocker-Wheeler Generator, complete with pulley, base and rheostat.

2093—One 70-kw., 125-volt, 575-r.p.m. Westinghouse, type S, compound wound Generator, complete with base, pulley and rheostat.....**Immediate**

2112—One 55-kw., 125-volt, 650-r.p.m. Crocker-Wheeler, compound wound Generator, complete with base, pulley and rheostat.....**Immediate**

1922A—One 25-kw., 250-volt, 700-r.p.m. Allis-Chalmers, compound wound Generator, complete with base, pulley and rheostat.

1850—One 10-kw., 125-volt, 1135-r.p.m., direct current, compound wound Westinghouse, type S Generator, complete pulley, base and rheostat.

2118—One 7½-kw., 125-volt, 850 r.p.m., compound wound General Electric type CE Generator, complete with base, pulley and rheostat.**Immediate**

BELTED A.C. GENERATORS

2059—One 200-kw., 2300-volt, 600-r.p.m., 3-phase, 60-cycle, General Electric, type ATB Generator, with pulley, base, direct connected exciter and field rheostat.....**Immediate**

2110—One 200-kw., 2300-volt, 600-r.p.m., 3-phase, 60-cycle Westinghouse Generator, with base, pulley, belted exciter and rheostat.....**3 weeks**

1930—One 60-kw., 2200-volt, 1200-r.p.m., 3-phase, 60-cycle Bullock-Allis Chalmers Generator, complete with base, pulley, rheostat and exciter.

TRANSFORMERS

1891—Three 100-kw., 60-cycle, single phase, 7200-13200-volt primary, 2200/1100 volt secondary, General Electric, O.I.S.C., type H Transformers.

OFFICES AND SHOPS

SEVENTH AND ADAMS STS., HOBOKEN, N. J.

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Hoboken 720-721

POWER MACHINERY EXCHANGE, Inc.

1 Montgomery Street, JERSEY CITY, N. J.

OIL ENGINE UNITS

4—160-kw. General Electric 3-phase, 60-cycle, 2300 volt, direct connected Diesel 3-cylinder oil engines

Gas Engine Units (A.C.) 3-phase, 60-cycle.

Kw.	Make	Volts	Engine
400	Wghse.	2300	Bruce MacBeth 4 cyl.
200 (3)	F.M.	2300	F.M. 4 cyl.
200	F.M.	440-220	F.M. 4 cyl.
150	F.M.	2300	F.M. 4 cyl.
152	G.E.	240	Bruce Macbeth, 4 cyl.
120	Burke	440-220	Bruce MacBeth 4 cyl.
75	G.E.	250	Walrath 3 cyl.
50	G.E.	2300	Rathburn 2 cyl.
50	F.M.	230	F.M. 3 cyl.

Gas Engine Units direct current

Kw.	Generator	Volts	Engine
200 (2)	Al. Chal.	250	Al. Chal.
150	Wghse.	250	Wghse.
125 (2)	W. E.	250	De LaVergne
75	Wghse.	250	Wghse.
47½	F.M.	125	F.M.

A. C. Units 3-phase, 60-cycle

Kw	Generator	Volts	Engine
850	Allis-Chal.	2300	Corliss
750	G. E.	2300	Lentz, cr. comp.
675	G. E.	480	Ball Corliss, (new)
600	G. E.	2300	Rice-Sargent cor.
500	G. E.	2300	Allis ver. cor.
500	Westinghse	480	Lentz tandem
450	Burke	2300	Ball ver. c. c.
450	G. E.	2300	Allis cor. c. c.
400	G. E.	2300	McI. & S. ver.
400	Westinghse	480	Ball 4-valve
330	Stanley	2300	Harrisburg cor.
325	G. E.	2300	For direct connect.
300	Allis-Chal.	600	Parsons turbine
250	Westinghse	440	Westinghouse vert.
250	G. E.	2300	Harrisburg tandem
156	Westinghse	480	Parsons turbine
150	G. E.	200	American Ball
150	Westinghse	440	Chand. & Taylor
110	Allis-Chal.	220	Bates vertical
100	Ridgway	2300	Ridgway
100	Cr.-Wheel.	240	Engine type gen.
100 (2)	Westinghse	2300	Ballwood
75	Westinghse	2300	Russell
75	G. E.	2300	Ideal tandem
50	Westinghse	2300	Harrisburg simp.
50	Westinghse	2300	Vertical
50	Terry	440	Turbine
36	G. E.	240	Fleming
35	W. E.	220	Sturtevant
125 (2)	Al. Chal.	440-220	Buckeyes (14½x18)
125	Wghse.	240	Parsons Turbine
75	G. E.	2300	Skinner

A. C. Units 2-phase, 60-cycle, 220 volt

Kw.	Generator	Engine
500	Westinghse	Harrisburg, 4-volt $7500
325	Westinghse	Erie tandem
250	C. W.	Erie Ball Corliss
125	Al. Chal.	Buckeye
100	Ridgway	Ridgway
100 (2)	Westinghse	Ballwood
75	G.E.	Skinner

Boilers (HRT)

Size	Pressure
72x20 (4)	150 lb.
78x18 (2)	150 lb.
72x20 (2)	150 lb.
72x18 (4)	125 lb.
72x16 (4)	125 lb.
66x16 (4)	125 lb.
66x16 (4)	100 lb.

Water Tube Boilers

H.P.	Make	Pressure
604 (2)	B. & W.	200 lb.
600 (4)	Stirling	150 lb.
600 (2)	B. & W.	200
576 (2)	Stirling	200
500 (4)	B. & W.	200
500 (2)	Heine	200
500 (3)	Wickes ver.	175
400 (2)	Stirling	160
400 (2)	Erie City	150
350 (3)	B. & W.	160
304 (2)	Stirling	160
300 (3)	Heine	160
300 (2)	B. & W.	165
300 (5)	B. & W.	200
250 (4)	B. & W.	200
250 (4)	Heine	160
200 (2)	Heine	160
200 (4)	B. & W.	160

Compound Corliss Engines

Cylinder	Make	Type
20—36x48	Allis	Tandem
12—36x28	Nordberg	cross. comp.
18—34x36	Watts Camp.	cross. comp.
18—32x42	Rice Sargent	cross. comp.
16—30x42	Vitler	cross. comp.
16—30x42	Bates	tandem
14—28x36	Greenwald	tandem
14—26x42	Watts Camp.	cross comp.
12—26x36	Twin City	cross comp.

Turbines

Kw.	Generator	Engine
7500	Westinghse	Parsons turbine
3750	Westinghse	Parsons turbine (new)
2000	G. E.	Horizontal turbine
1800	G. E.	Vertical turbine
1250	Westinghse	Parsons turbine
875 (3)	G. E.	Hydro. turbine
500	G. E.	Curtis turbine
400	Westinghse	Parsons turbine
100	Curtis	Horiz. turbine

3-Phase, 25-Cycle Apparatus

Frequency Changer; 700 Kw. Alternator with 3 phase, 60 cycle, 2300 volt Synchronous mo.
600 Kw. Wghse. 2300 v. Alt. with Corliss c.c. engine
400 Kw. Wghse. 2300 v. with Rice-Sargent c.c. engine
375 Kw. G. E. 440 v. with Buckeye 24x27 eng.
240 Kw. G. E. 440-220 v. Ames engine

Corliss Engines

Cylinder	Make
32x48	Allis-Chal.
24x48	Hewes Phillips
22x48	Allis
22x48	Rice Sargent
22x42	Allis
22x42	Bates
20x42	Hamilton
20x42	Nordberg
18x36	Hamilton
18x36	Allis-Chal.
16x42	Allis
16x42	Watts Campbell
16x32	Cooper
14x36	Hardie-Tynes
14x36	Hamilton
14x30	Hewes Phillips
12x30	Green
12x30	Filer Stowell
12x24	Wetherill
10x24	Fitchburg

Automatic Engines

Cylinder	Make
21x24	Harrisburg
17x18	Ridgway
16x16	Ballwood
15x14	Ideal
13x15	Erie City
02x18	Russell
12x14	Ideal
12x12	Erie Ball
11x15	Erie City
10x12	Ames

110-125 Volt Generators

Kw.	Generator	Speed
200	Allis-Chalmers	300
150 (2)	G. E.	600
120	Eddy	600
100	C. & C.	530
85	G. E.	790
75	G. E.	450
60	Westinghouse	800
45	G. E.	800
32½	Westinghouse	700
20	G. E.	1250
15	G. E.	800
11	G. E.	800
7½	G. E.	850
6	Westinghouse	1675

220-250 Volt Generators

Kw.	Generator	Speed
275	Jenny	500
225	G. E.	425
150 (2)	Ridgway	550
100	G. E.	575
75	G. E.	800
45	G. E., type DLC	775
37½	G. E., 3-wire	850

220-250 Volt D. C. Units

Kw.	Generator	Engine
300	C. W.	Wetherill Corliss
300	G. E.	Ridgway
250	Westinghouse	Ball
200	Westinghouse	Buckeye heavy duty
160	G. E.	Harrisburg
160	G. E.	Engine type
150	Ridgway	Ridgway
150	G. E.	Erie Ball 4-valve
125	Westge 3-wire	Chandler Tay., S.C.
115	W. E.	Russell 4-valve
100	Westge 3-wire	Erie
100	G. E.	Skinner
100 (2)	Sturtevant	Sturtevant vertical
100 (2)	G. E. 3-wire	Ames
100	Akron	Engine type
75	Westinghouse	Westinghouse gas
75	Ridgway	Ridgway S.C.
75	Westge 3-wire	Skinner
75	Westinghouse	Harrisburg S.C.
62½	Westge 3-wire	Skinner
62½	G. E.	Ames
50	G. E.	Brownell
50	Allis-Chalmers	Chan. Taylor S.C.
50	C. W.	Frost
40	Ridgway	Ridgway S.C.
35	Northern	Ide
30	G. E.	Harrisburg
20	W. E.	Vertical

125 Volt, D.C. Units

Kw.	Generator	Engine	Price
150	Sprague	Harrisburg	$2750
125	G. E.	Ridgway	2500
100	Wghse.	Skinner	2000
75	C. W.	Ames	1650
75	Ridgway	Ridgway	1750
75	G. E.	Bruce McB. gas	2500
65	Burke	Harrisburg	1200
50	G. E.	Harrisburg	1200
50	C. W.	Ames	750
35	Bullock	Ridgway	900
20	Northern	Ideal	750
15	Cr.	A. & S.	450
15	Sprague	Ames	550

NEW ELECTRIC MOTORS

IN PITTSBURGH STOCK

HARRIS PUMP & SUPPLY COMPANY

WHEN YOU WANT PUMPS THINK OF HARRIS

The Big Motor House

316-18-20-22 Second Avenue, 319-321 First Avenue, Pittsburgh, Pa.

We Have No Used Motors

DIRECT CURRENT—250-VOLT

Qu.	Hp.	Voltage	Speed	Type	Make
1	½	230	1700	RC	G. E.
5	2	230	1725	CD	Wghse.
1	2	230	1700	RC	G. E.
10	3	230	1725	CD	Wghse.
7	3	230	1150	RC	G. E.
12	3	230	1150	SK	Wghse.
1	3	230	1700	RC	G. E.
1	3½	230	850	SK	Wghse.
11	5	230	1150	RC	G. E.
7	5	230	1200	SK	Wghse.
1	5	230	1800	SK	Wghse.
1	7½	230	1150	SK	Wghse.
1	7½	230	850	SK	Wghse.
3	7½	230	1150	RC	G. E.
8	7½	230	1700	SK	Wghse.
7	7½	230	1700	RC	G. E.
2	10	230	850	RC	G. E.
16	10	230	1150	SK	Wghse.
6	10	230	1700	SK	Wghse.
11	10	230	1150	RC	G. E.
1	10	230	1700	...	Reliance
3	10	230	1150	RC	G. E.
3	10	230	1700	RC	G. E.
3	15	230	1150	RC	G. E.
1	10	230	850	SK	Wghse.
2	10	230	850	RC	G. E.
6	15	230	1700	RC	G. E.
1	15	230	1100	SK	Wghse.
1	20	230	1100	SK	Wghse.
1	20	230	1150	RC	G. E.
1	20	230	800	RC	G. E.
4	20	230	1700	...	Reliance
1	25	230	1755	CS	Wghse.
1	25	230	825	SK	Wghse.
5	30	230	1700	SK	Wghse.
1	30	230	730	SK	Reliance
2	40	230	1700	SK	West Rel.
2	40	230	1750	...	.....
1	50	230	750	SK	Wghse.

DIRECT CURRENT—550 Volt

5	3	550	1200	SK	Wghse.
1	3	550	1900	CD	Wghse.
6	5	550	720	SK	Wghse.
4	5	550	1300	RC	G. E.
13	5	550	1200	SK	Wghse.
1	7½	550	850	SK	Wghse.
5	7½	550	1150	SK	Wghse.
1	7½	550	1800	RC	G. E.
1	10	550	900	RC	G. E.
1	10	500	1800	RC	G. E.
4	10	550	1250	RC	Wghse.
1	10	550	1150	SK	Wghse.
5	10	550	1700	SK	Wghse.
1	20	550	1700	SK	Wghse.
1	30	550	900	RC	G. E.
1	30	550	1755	...	Reliance
2	15	550	1800	RC	G. E.
2	15	550	1250	RC	G. E.
1	15	550	900	RC	G. E.

SINGLE PHASE

1	1½	110-220	1750	...	Century
1	2½	104-208	1165	...	Century

VERTICAL TYPE MOTOR

2	½	104AC	1750	P2	Century
1	1	104AC	1750	P4	Century

DIRECT CURRENT—115 Volt

1	½	115	1700	RC	G. E.
1	1	115	1150	RC	G. E.
1	2	110	1200	...	Peerless

ALTERNATING CURRENT
220-Volt, 3-Phase, 60-Cycle

1	1	220	3600	KT	G. E.
3	1	220	1200	KT	G. E.
1	1	220	1800	KT	G. E.
1	2	220	1700	BA	Wagner
1	2	220	1200	KQ	G. E.
9	2	220	1800	KT	G. E.
1	2	220	1130	KT	G. E.
1	2	220	1120	CS	Wghse.
1	2	220	1725	CS	Wghse.
7	3	220	1200	KT	G. E.
5	3	220	1130	CS	Wghse.
7	3	220	1800	KT	G. E.
7	3	220	1755	CS	Wghse.
11	5	220	1200	KT	G. E.
6	5	220	1800	KT	G. E.
2	5	220	1160	BP	Wagner
2	5	220	1720	BP	Wagner
1	5	220	1200	CS	Wghse.
1	5	220	1735	CS	Wghse.
1	7½	220	1500	KT	G. E.
2	7½	220	1130	CS	Wghse.
1	7½	220	1150	AS	Century
5	7½	220	1150	KT	G. E.
5	7½	220	1140	BW	Wagner
1	7½	220	1200	MT	G. E.
1	7½	220	1800	KT	G. E.
1	10	220	860	CS	Wghse.
2	10	220	1150	AS	Wagner
4	10	220	1800	KT	Reliance
4	10	220	1165	KT	Wghse.
4	10	220	1800	CS	Wghse.
3	15	220	1140	BW	Wagner
1	15	220	1200	...	Reliance
2	15	220	1200	CS	Wghse.
1	15	220	1160	CW	Wghse.
1	15	220	1750	BP	Wagner
2	15	220	1160	KT	G. E.
2	15	220	1750	CS	Wghse.
1	15	220	1800	CW	G. E.
1	20	220	870	BP	G. E.
2	20	220	1200	...	Reliance
1	20	220	1150	AS	Century
1	20	220	1200	KT	G. E.
6	25	220	1800	KT	G. E.
7	25	220	1750	CS	Wghse.
1	25	220	1165	KT	G. E.
1	30	220	1750	CS	Wghse.
4	40	220	1745	KT	G. E.
1	40	220	1800	I	G. E.
2	40	220	1165	KT	G. E.
1	50	220	870	KT	G. E.
6	50	220	1750	KT	G. E.

ALTERNATING CURRENT
440-Volt, 60-Cycle, 3-Phase

Qu.	Hp.	Voltage	Speed	Type	Make
2	50	220	1160	KT	G. E.
1	50	220	1150	CW	Wghse.
1	100	220	1800	KT	G. E.
1	¾	440	1140	CS	Wghse.
1	1	440	1800	KT	G. E.
1	1	440	1200	KT	G. E.
3	2	440	1800	KT	G. E.
3	3	440	1150	KT	G. E.
2	3	440	1800	KT	G. E.
1	3	440	1150	CS	Wghse.
6	55	440	1200	KT	G. E.
3	5	440	1755	CS	Wghse.
1	5	440	1720	BP	Wagner
1	7½	440	850	CS	Wghse.
5	7½	440	1150	CS	Wghse.
1	7½	440	1200	KT	G. E.
12	10	440	1150	CS	Wghse.
1	10	440	860	CS	Wghse.
1	10	440	1740	CS	Wghse.
2	10	440	860	...	Allis-Chal.
2	10	440	1165	KT	G. E.
3	15	440	1800	KT	G. E.
1	15	440	1200	...	Reliance
1	20	440	870	KT	G. E.
2	25	440	1165	KT	G. E.
1	25	440	1200	CS	Wghse.
5	25	440	1800	KT	G. E.
1	30	440	1160	3P	Allis-Chal.
1	30	440	1200	KT	G. E.
4	40	440	1745	KT	G. E.
2	50	440	1200	KT	G. E.
1	50	440	870	KT	G. E.
2	50	440	1735	CS	Wghse.
1	75	440	870	KT	G. E.
1	75	440	720	KT	G. E.
2	75	440	1760	CS	Wghse.
2	75	440	1755	I	G. E.
2	100	440	1760	CS	Wghse.
1	100	440	1125	CS	Wghse.
1	100	440	690	I	G. E.
1	150	440	1760	CS	Wghse.
1	100	440	1755	I	G. E.

Reliable—POWER PLANT MACHINERY

STEAM ENGINES

1—500-hp., 26 x 48 Watts-Campbell Corliss.
1—350-hp., 24 x 48 Bates Corliss.
1—250-hp., 18 x 36 Hamilton Corliss.
1—125-hp., 14 x 36 Hamilton Corliss.
1—105-hp., 14 x 20 H. S. & G.
1— 75-hp., 13 x 16 Chandler & Taylor.
1—100-hp., 13 x 12 Ball.
1— 40-hp., 11 x 14 Brownell.
1— 35-hp., 10 x 15 Erie.
1— 30-hp., 8 x 14 H. S. & G.
1— 25-hp., 8 x 8 Brownell.

MOTORS, A.C.

3-Phase, 60-Cycle, Slip Ring Type

No.	Hp.	Make	Volt	Rpm.	Form
1	15	New General Electric	440	1200	M
1	15	New General Electric	220	900	M
1	25	New General Electric	440	1200	M
1	30	New General Electric	440	1200	M
1	40	New General Electric	440	900	M
1	50	New General Electric	440	900	M
1	50	New Allis-Chalmers	440	900	ANY
1	75	New General Electric	440	900	M
1	100	New General Electric	440	900	M
2	150	New General Electric	440	600	M
2	200	Used General Elec. (Sy)	440	600	ATI

A. C. GENERATORS

Belted and Direct Connected

1—1250-kw. Westinghouse-Parsons, 3-phase, 60 cycle, 2300-volt, 1200-r.p.m. Turbo Generator Set without condenser.
1—750-kw. General Electric, 3-phase, 60-cycle, 2300-volt Turbo Generator Set with condenser.
1—New 675-kva. General Electric, 3-phase, 60-cycle, 480-220 volt, 150-r.p.m., A.C. Generator, with direct connected exciter and direct connected to a new 26 x 33 Ball Corliss type engine.
1—100-kw. General Electric, 3-phase, 60-cycle, 2300-volt Turbo Generator Set with condenser.
1—85-kw. Allis-Chalmers, 3-phase, 60-cycle, 2300-volt, 900-r.p.m. revolving field Alternator.
1—90-kva. Electric Machinery Co., 3-phase, 60-cycle, 2300-volt, 1200-r.p.m. revolving field Alternator.
1—75-kw. Westinghouse, 3-phase, 60-cycle, 440-volt, 720-r.p.m. revolving armature Alternator.

DIRECT CURRENT MOTORS

No.	Hp.	Make	Volts	Rpm.
1	50	Rebuilt Allis-Chalmers	250	1050
1	40	Rebuilt Western Elec.	250	900
1	30	Rebuilt Northern	250	600
1	25	Rebuilt Fisher	250	600
1	20	New General Electric	250	1150
1	15	Rebuilt Allis-Chalmers	220	1200
2	10	Rebuilt Allis-Chalmers	220	1200
5	7½	New General Electric	230	1150
1	7½	Rebuilt Interpole	220	550-1100
6	5	New General Electric	230	1150

MOTOR GENERATOR SETS

1—37½-kw. Lincoln, 125-volt, 900-r.p.m., D.C. Generator, direct connected to a 60-hp., 3-phase, 60-cycle, 220-volt induction motor, with switchboard and instruments.
1—100-kw. General Electric, 250-volt Generator, direct connected to a General Electric, 3-phase, 60-cycle, 2300-volt synchronous motor with switchboard and instruments.
1—100-kw. Westinghouse Synchronous Motor Generator Set as above.

BOILERS

3—500-hp. Babcock & Wilcox, 200 lb. pressure.
4—350-hp. Stirling, 190 lb. pressure.
2—400-hp. Stirling, 160-lb. pressure.
3—350-hp. Babcock & Wilcox, 150-lb. pressure.
2—250-hp. Stirling, 150-lb. pressure.
8—150-hp., 72 x 18, high pressure, return tubular.
1—125-hp., 72 x 16, high pressure, return tubular.
2—100-hp., 66 x 16, return tubular.
1—100-hp., 66 x 16, high pressure.
1— 70-hp., 54 x 16, return tubular.
1— 60-hp., 54 x 14, high pressure.
1— 50-hp., 48 x 14, return tubular.
1— 40-hp. firebox or locomotive type on skids.
1— 30-hp., 44 x 10, return tubular.
1— 20-hp., 36 x 101-in. vertical.
1— 15-hp., 36 x 83 in. vertical.
1— 10-hp., 30 x 83 in. vertical.

MOTORS

Alternating Current, 3-Phase, 60-Cycle Squirrel Cage

No.	Hp.	Make	Volts	Rpm.
4	3	New General Electric	220	1200
1	5	Used General Electric	440	1200

No.	Hp.	Make	Volts	Rpm
1	7½	New General Electric	220	1800
1	10	New General Electric	220	1800
1	15	Used Crocker-Wheeler	440	850
1	15	Used General Electric	440	1200
1	20	Used Westinghouse	220	1160
1	25	Used General Electric	440	1200
1	25	Used General Electric	440	600
1	25	New General Electric	220	900
1	25	New Allis-Chalmers	220	575
1	30	New General Electric	220	1200
1	40	New General Electric	220	900
2	50	New General Electric	220	900
2	75	New General Electric	220	900
1	75	Used Westinghouse	220	1120
1	75	Used Westinghouse	220	700
2	100	New General Electric	220	900
1	150	Used Westinghouse	2300	720

(Any of the above 220-volt motors can be furnished for 440-volt or vice versa.)

DIRECT CURRENT GENERATORS

Belted and Direct Connected

1—10.5-kw. Western Electric, 125-volt, 300-r.p.m., compound wound, belted Generator.
1—17½-kw. Triumph, 115-volt, compound wound Generator, direct connected to an 8 x 8 Troy vertical automatic engine.
1—50-kw. Allis-Chalmers, 125-volt, 250-r.p.m, compound wound Generator, direct connected to a 12 x 12 Ball automatic engine with switchboard.
1—100 Kw. Triumph, 125-volt, 675-r.p.m., compound wound, belted type generator.
1—Used 100-Kw. Bullock, either 125 or 250 volts, D.C. compound wound multipolar generator direct connected to a Ball automatic enclosed type engine with switchboard.
1—150-kw. Morgan-Gardner, 250-volt, 550-r.p.m., 600-ampere, compound wound, belted type Generator.
3—150-Kw. each Milwaukee Electric Company, 250-volt, D.C. compound wound Generators each direct connected to an 18 x 16 Harrisburg automatic engine with switchboard.
1—200-kw. Jantz & Leist, 125-volt, D.C. Generator, direct connected to a 22 x 22 Skinner automatic, heavy duty self-oiling engine.

THE RANDLE MACHINERY COMPANY

Established 35 Years

Located ONLY at **1822 POWER ST., CINCINNATI, OHIO**

THREE PHASE 60 CYCLE MOTORS

Qu	H.P.	Make	Volts	Type	Speed
1	¼	Robbins & Myers, New	110		1700
2	⅓	Jenny	110		1200
1	1	Westinghouse, New	220	CSA	1140
1	3	Westge. 50 degree, New	220	CS	1160
1	5	Westge. 50 degree, New	220	CS	1750
14	5	General Electric	440	KT	1200
1	5	Crocker-Wheeler	550	Q	1720
20	7	General Electric, M. only (New Fairbanks-Morse resistance starters for above)	550	KT	1200
6	7½	General Electric, M .only (New Fairbanks Morse resistance starter for above)	550	KT	1800
3	7½	General Electric, New	440	KT	1800
4	7½	Westinghouse, New	220	CS	1760
1	10	Burke	220	EM	1200
1	10	General Electric, New	220	KT	1800
3	10	General Electric, New slip ring, no starter	220	KT	1800
1	10	Westinghouse, New	220	CS	1150
5	15	Westinghouse, New	220	CS	1155
30	20	Fairbanks-Morse	220-440	KBV	1200
2	25	Westinghouse, New	220	CS	865
1	25	General Electric, New	440	KT	900
5	25	Wagner	220-440	BP	1120
1	30	Westinghouse, New	220	CS	1170
1	30	Westinghouse, New	220	CS	685
6	30	General Electric, New	440	KT	1200
2	30	General Electric, New	440	KT	900
1	30	Wagner, New	440	BP	850
1	40	General Electric, New	440	KT	1200
2	40	Westge., New, Slip Ring	220	CW	860
2	50	General Electric, New	440	KT	900
1	50	Allis-Chalmers	220		1750
1	75	Westinghouse, New	220	CS	720

u	H.P.	Make	Volts	Type	Speed
1	75	Westge., New, RF controller	440	CW	840
1	100	Allis-Chalmers	550		690
2	100	General Electric	440	KT	1800

THREE PHASE 25 CYCLE MOTORS

1	½	Westinghouse	220		690
10	⅔	General Electric	220	C	750
4	¾	General Electric	220		1500
1	¾	Westinghouse	220	C	890
1	1	Crocker-Wheeler	220		1420
2	1	Westinghouse	220	C	690
2	1	General Electric	220		750
6	3	General Electric	220		750
1	3	General Electric	220		750-1500
1	3	Crocker-Wheeler	220		710
1	5	Westinghouse	220	C	710
2	5	Crocker-Wheeler	220		715
7	5	General Electric	220		750
5	7½	General Electric	220		750
6	10	Westinghouse	220	C	710
1	12	General Electric	220		1500
1	15	Westinghouse	220	C	710
1	15	General Electric	220		750
2	15	Allis-Chalmers	220		750
2	20	Westinghouse	220	C	710
2	20	General Electric	220		750
1	25	General Electric	220		750
7	30	Westinghouse	220	C	720
1	30	General Electric	220		750
10	40	Westinghouse	220	C	720
1	50	Allis-Chalmers, intermittent duty slip ring drum controller	440	ANY	480
2	50	Westinghouse	220	C	480
1	50	Westinghouse	220	C	710
1	60	General Electric	440	KT	500
1	60-45-30	General Electric	440		500-375-200

GEORGE SACHSENMAIER CO.,

Warehouse, 928-30-32 N. 3rd Street, Philadelphia, Pa.
Office, 926 N. 3rd Street

SEND FOR CATALOGUE

SINGLE PHASE MOTORS

New and Up-to-Date and lots of them—all bargains

Special Introductory Offer

2000—Westinghouse ¼ H.P., Type C.A.H. 110 Volts, 60 cycle, 1750 R.P.M., New enclosed Motors, with grooved pulleys, Price, $22.50 each, net.

Also the following 60 cycle Motors, ready for immediate shipment. All New.

Quan.	H.P.	Make and Type		Voltage	R.P.M.	Trade Price No Discount
200	1/6	Westinghouse	CA	110	1750	$18.50
100	1/4	General Electric	SA	110	1750	23.40
25	1/3	General Electric	SA	110	1750	29.75
25	1/3	General Electric	SA	220	1750	30.75
50	1/2	Robbins & Myers	P18	110	1750	40.00
50	1/2	Robbins & Myers	P18	220	1750	41.00
50	1/2	Westinghouse	CA	220	1750	45.00
25	1/2	Emerson		110	700	75.00
50	3/4	Westinghouse	CA	220	1750	55.00
50	3/4	Westinghouse	CA	110	1140	65.00
12	1	Westinghouse	AR	110-220	1750	82.50
25	2	Westinghouse	AR	110-220	1750	119.25
20	3	Westinghouse	AR	110-220	1750	142.65
10	3	Westinghouse	AR	110-220	1140	188.40
25	5	Westinghouse	AR	110-220	1750	188.40

In addition to the above, we have 200 single phase new motors—General Electric—Type RI Century, Wagner and Emerson makes in all sizes from ¼ to 5 H.P. Write for prices.

We carry a large stock of alternating current, polyphase, squirrel cage type and slip ring type motors—direct current motors and generators—exhaust fans and blowers—What do YOU need?

Reliable Electric Motor Company, Inc.

165-167 Grand Street, New York City

BROWN-HUNKELE CORPORATION

NEW JERSEY'S ELECTRICAL CLEARING HOUSE

LARGE STOCK OF SINGLE PHASE, A. C. & D. C. MOTORS AND PLATING DYNAMOS

WRITE—PHONE—WIRE YOUR REQUIREMENTS

12-24-26 MECHANIC STREET, NEWARK, N. J.

Engine Generator Sets

1—540 Kw. G. E., 3-phase, 60-cycle, 240-v., 150 rpm., direct connected exciter on shaft, with 26-in. x 33-in. Corliss valve type Ball engine, speed 150 rpm., 800 I.H.P.; new in original crate.

1—250 Kw., 2300-v., 60-cycle, 3-phase Sprague, direct connected to Erie Ball Cross Compound engine.

1—125 Kw., 250-v., 250 rpm., 500 Amp. D.C. Crocker-Wheeler Generator, direct connected to simple non-condensing straight line engine, complete with Bed Plate only.

1—75 Kw., 2-phase, 1150-v., 60-cycle Generator, 257 rpm., direct connectcd to Erie Ball engine, complete with exciter, switchboard and instruments.

1—70 Kw. 2-phase, 2300-volt, 60-cycle,, 277 Erie Ball Engine complete with exciter, switchboard and instruments.

1—50 Kw. Western Electric Generator, 120-v., D.C., 265 rpm., 6-pole compound, direct connected to an Ideal Centercrank Harrisburg engine, complete with switchboard.

Belted Generators A.C.

2—150 Kw., 125-v., 625 rpm., compound wound, direct current, Ridgeway belted type Generator with rheostat and switchboards.

1—150 Kva., 2-phase, 60-cycle, 220-v., Westinghouse revolving field, 900 rpm. Generator, complete with exciter, switchboard and instruments.

1—150 Kw., 3-phase, 60-cycle, 220-v., G. E. 720 rpm. revolving field Generator, with 7½ Kw. exciter, complete with switchboard and instruments.

2—75 Kw., 2-phase, 60-cycle, 2200-v., 900 rpm. Westinghouse Generator, complete with exciters and switchboards

1—60 Kw, 2-phase, 220-v., 60-cycle, 900 rpm. Stanley, with exciter and switchboard.

1—40 Kw., 220-v., 60-cycle, 2-phase Stanley, with exciter and switchboard.

1—35 Kw., Triumph belted, 3-wire Generator, D.C., 120-240-v., 975 rpm., complete with Balancing Coil.

Motor Generator Sets

1—200 H.P., 200-v., 60-cycle, 2-phase, 900 rpm. West., to 200 Kw. 125-v., compound wound, complete. Brand new.

1—4-Bearing Westinghouse, 200 H.P., 220-v., 400 Amp., 60-cycle, 2-phase, 580 rpm., type CCV West. to 150 Kw., 125-250-v., 600 Amp., 580 rpm., three-wire Generator complete with switchboard equipment and control.

1—A.C. 75 Kw., 1100-v., 1-phase, 60-cycle, 900 rpm. West. to 100 H.P., 220-v., 2-phase, 60-cycle, 900 rpm. West. with starter, transformers and switchboard complete.

D.C. Generators

1—45 Kw., 875 rpm., 220-v., 350 Amp., Diehl compound wound.

1—40 Kw., 220 rpm., 250-v., compound wound, D.C. Crocker-Wheeler, for direct connection to engine.

1—35 Kw., 750 rpm., 220-v., Crocker-Wheeler.

1—30 Kw., 600 rpm., 250-v., 250 Amp., Elwell Parker.

Gas and Oil Engine Sets

1—28 Kw., 125-v., 425 rpm., 224 Amp., Diehl Generator, to 40 H.P., 425 rpm., 2-cylinder Samuel-Moore oil engine.

2—60 Kw., 125-v., D.C. Crocker-Wheeler Generator to semi-Diesel oil engines.

2—75 Kw., 250-v., D.C., 215 rpm., Crocker-Wheeler to Alberger gas engines.

Direct Current, 110 V. Motors

1—200 H.P. Shunt, 300 rpm. Crocker-Wheeler only.

1—100 H.P. Shunt, 300 rpm. Crocker-Wheeler only.

1—15 H.P. Sturtevant D.C., 125-v., 150/450 rpm. (Shunt interpole).

A.C. 60 Cycle, 3 Phase, 440 Volt

2—50 H.P., 1800 rpm., Allis-Chalmers.

A.C. 60 Cycle, 2 Phase, 220 Volt

1—100 H.P. Ideal Slip Ring, 870 rpm., complete with control and grids; new.

1—40 H.P. Allis-Chalmers, 865 rpm.; used.

2—25 H.P. Fairbanks-Morse, 900 rpm. New type H.

1—25 H.P. Fairbanks-Morse, 1200 rpm. New type H.

2—25 H.P. Fairbanks-Morse, 900 rpm. New type B.

1—20 H.P. Fairbanks-Morse, 1200 rpm. Used type H.

1—10 H.P. Bell, 1800 rpm. Used.

1—7½ H.P. Western Electric, 1140 rpm.; used.

3—7½ H.P. Fairbanks-Morse, 1200 rpm.; new type B.

3—5 H.P. Westinghouse, 1700 rpm.; used.

2—3 H.P. Fairbanks-Morse, 1200 rpm.; new type B.

A.C. 60 Cycle, 3 Phase, 220 Volt

1—75 H.P., 900 rpm., Western Electric; used.

1—50 H.P., 600 rpm., G. E.; used.

1—40 H.P., 865 rpm., Allis-Chalmers; used.

1—30 H.P., 1200 rpm., F. M.; new type B.

3—25 H.P., 900 rpm., Westinghouse; used.

2—20 H.P., 900 rpm., F. M.; used type B.

1—15 H.P., 1200 rpm., G. E.; used.

1—15 H.P., 900 rpm., G. E.; used.

1—10 H.P., 1200 rpm., G. E.; used.

1—7½ H.P., 1200 rpm., R. Meyers; used.

3—5 H.P. 1200 rpm., G. E.; used.

3—3 H.P., 1200 rpm., G. E.; used.

2—2 H.P., 1200 rpm., F. M.; used.

3—1 H.P., 1200 rpm., G. E.; used.

1—50¼ H.P., 1200 rpm., Westinghouse and Fidelity; used.

1—150 H.P., 720 rpm., G. E., S. C.; used.

Direct Current, 220 V. Motors

1—70 H.P. West., 220-v., 850 rpm. Compound, type S.

1—35 H.P. G. E., 220-v., 560 rpm.

1—20 H.P. West., 975 rpm. Type S.

1—40 H.P. West., 700 rpm. Type S.

1—15 H.P. G. E., 1100 rpm. Type C. E.

INDEPENDENT ELECTRIC MACHINERY CO.

CENTRAL STREET and GOODRICH PLACE, KANSAS CITY, MO.

SEE THE INDEPENDENT FIRST

SEE THE INDEPENDENT FIRST

25-CYCLE, 3-PHASE, 220-440 VOLT MOTORS

No.	H.P.	Name	Speed
1	1	Richmond	1420
1	1	General Electric	1500
5	2	General Electric	1500
2	3	Ideal	1400
3	3	Robbins & Myers (New)	1400
2	3	General Electric	1500
1	5	Western Electric	1420
1	5	Westinghouse	Var.
2	7½	Robbins & Myers (New)	1400
1	7½	General Electric	1500
1	10	Ideal	720
1	15	General Electric	1500
1	15	Ideal	1430
1	15	Burke	750
1	20	Fairbanks-Morse	1500
1	40	Westinghouse	710
2	100	General Electric 2200-volt	750

60-CYCLE, 3-PHASE, 220-VOLT MOTORS

No.	H.P.	Name	Speed
2	½	Fairbanks-Morse	1200
1	1	General Electric	Var.
7	1	Robbins-Myers—New	1750
3	1	Robbins-Myers—New	1150
10	2	Robbins & Myers (New)	1750
2	2	Robbins-Myers	1150
13	3	Robbins & Myers (New)	1750
6	3	Robbins & Myers (New)	1150
20	5	Robbins & Myers (New)	1750
4	5	Robbins & Myers (New)	1150
3	5	Crocker-Wheeler (New)	1750
1	5	Wagner (New)	1140
2	5	Allis-Chalmers	1150
8	7½	Robbins & Myers (New)	1150
9	7½	Robbins & Myers (New)	1750
1	7½	Richmond	1140
1	7½	Northwestern	1900
1	7½	General Electric	1800
2	7½	Robbins & Myers (New)	850
1	10	Allis-Chalmers, slip ring	1150
1	10	Wagner (New)	1140
6	10	Robbins & Myers (New)	1150
2	10	Robbins & Myers (New)	1750
1	10	Robbins & Myers (New)	850
5	15	Robbins & Myers (New)	1750
2	15	Robbins & Myers (New)	1150
2	15	Robbins & Myers (New)	850
1	20	Robbins & Myers (New)	1150
1	20	Robbins & Myers (New)	1750
1	20	Robbins & Myers	850
2	25	Robbins & Myers (New)	1750
1	25	Robbins & Myers (New)	1150
2	25	Robbins & Myers (New)	850
1	25	Lincoln	2200 V.—1200
1	30	Robbins & Myers (New)	1150
1	30	Wagner	1140
1	30	Allis-Chalmers	1160
1	30	West. El., Slp.rg.	2200 V.— 350
1	35	Wagner	1730
1	35	General Electric	2200 V.—1150
1	40	Allis Ch., Sq. Cg.	2200 V.— 865
1	40	Allis-Chalmers—New—S.R.	860
1	50	Allis-Chalmers—New—S.R.	690
1	50	Westing., Slp rg.	2200 V.— 725
1	50	Allis Ch., Sq. Cg.	2200 V.— 865
1	50	Allis Chalmers Slip Ring	865
1	50	Allis Ch., Slp. rg.	2200 V.— 865
1	50	Allis-Chalmers	575
1	50	Allis-Chalmers, slip ring	875
1	50	Allis-Chalmers	1160
1	65	Allis-Chalmers	575
1	75	Ft. Wayne	900
1	75	General Electric—Sl. Rg.	900
1	75	Allis-Ch., Slp. rg. 2200V—	865
2	100	Allis Chalmers (slip ring) 2200V.	865
1	100	General Electric—2200 V.	695
1	125	Allis-Chalmers	1800
1	200	Allis-Chalmers	580

220 VOLT D.C. MOTORS

No.	Hp.	Name	Speed
3	5	Robbins & Myers	1400
1	5	Reliance	1750
1	5	Robbins-Myers	900
1	5	Northern	1150
1	7½	General Electric	815
1	5	Crocker-Wheeler	960
1	7½	Browning	935
1	7½	Westinghouse	1350
1	7½	Ideal	1500
1	7½	General Electric	1300
1	7½	Northern	1650
5	10	Crocker-Wheeler	825
2	10	Northerr Back-gear	1200
1	10	American Engine Co.	1140
2	10	Allis-Chalmers	1250
1	10	Westinghouse	1150
1	15	Electric Mchy. Co.	1050
1	15	General Electric (Crane)	600
1	15	Northern	535
3	30	General Electric (Vertical)	1500
1	110	Crocker-Wheeler	560

110-VOLT D.C. GENERATORS

No.	Kw.	Name	Speed
1	15	Phenix	900
1	15	Northern	750
1	50	G. E.	1150
1	50	Eddy	800
1	75	W. E., engine type	275

220-VOLT D.C. GENERATORS

No.	Kw.	Name	Speed
1	17½	Triumph	1200
1	60	Commercial	700
1	60	Westinghouse	850
1	75	Northern	700
1	80	Thompson-Ryan	600
1	80	Milwaukee	650
1	125	Ft. Wayne	600

DIRECT CONNECTED SETS

1—30-kw., 220-volt, 300-r.p.m. Akron generator direct connected to 10 x 10 Buffalo Forge Co. engine, complete.

1—60-kw., 125-volt, 280-r.p.m. General Electric generator, direct connected to 11 x 12 G. E. Marine steam engine, complete.

1—75-kw., 220-volt, 275-r.p.m. Crocker Wheeler generator, direct connected to a 15 x 16 Harrisburg-Fleming steam engine with balancer set.

ALTERNATORS

1—50 kva., 2200 volt, 60 cycle, 3 phase, 1200 r.p.m. Westinghouse alternator, complete.

1—62½ kw., 2200 volt, 60 cycle, 3 phase, 300 r.p.m. Bullock alternator, direct connected to an Almes steam engine, all complete.

1—75 kva., 2300 volt, 60 cycle, 1 phase, 900 r.p.m. General Electric alternator complete.

1—80 kva., 2300 volt, 60 cycle, 3 phase, 225 r.p.m. Ft. Wayne alternator, direct connected to 110 hp. Buckeye Producer Gas Engine, complete.

1—85 kva., 2300 volt, 60 cycle, 3 phase, 277 r.p.m. Allis Chalmers alternator direct connected to an Erie City steam engine, 12 x 12, all complete.

1—100 kva., 2300 volt, 60 cycle, 3 phase, 277 r.p.m. Westinghouse alternator, direct connected to 125 hp Erie engine.

3—100-kw., 440-volt, 60-cycle, 3-phase, 3600-r.p.m., General Electric Curtis type turbines complete with jet condensers for each machine driven by steam pumps, two synchronous motor generator exciter sets, one Curtiss turbine exciter set all complete with necessary rheostats and nine panel switchboard.

1—150 kva., 2300 volt, 60 cycle, 3 phase 200 r.p.m. General Electric alternator, direct connected to a 14½ x 24 x 18 Mansfield automatic steam engine, complete.

1—150 kva., 2300 volt, 60 cycle, 3 phase, 720 r.p.m. Electric Machinery, alternator, complete with exciter.

"HONESTLY REBUILT" ELECTRICAL MACHINERY

You can purchase our product with the same assurance that you would buy New Electrical Machinery. For all practical purposes it is just as good.

SPECIAL OFFERINGS

3—100-kva. Westinghouse, 1-phase, 60-cycle Transformers, 13,200-12,600-12,000-volt primary 465-445-437-423-volt, sec. rebuilt by Westinghouse. Price $1000 for all.

3—75-kw. General Electric, 1-phase, 60-cycle, Type H-RR Transformers, 2300-2185-2070-volt prim. 370-185-volt, sec. for 200-kw., 600-volt, D.C. rotary. Price for all $900.

200-hp., 3-phase, 60-cycle, 440-volt Westinghouse CCL, 1140-r.p.m. Motor, with starting panel. price $1000.

200-hp., 3-phase, 60-cycle, 440-volt Westinghouse CCL, 900-r.p.m. Motor with starter. Price $1250.

175-hp., 3-phase, 60-cycle, 2300-volt Allis-Chalmers 860-r.p.m., Slip Ring Motor, with Cutler-Hammer, drum controller, resistance and G.E. Oil Circuit Breaker. Price $1350.

6—132-hp., 3-phase, 60-cycle, 2300-volt General Electric, type I, form L Wound Rotor Motors. Price $1200 each.

2—100-hp., 3-phase, 60-cycle, 220-volt Allis-Chalmers, AN 1750-r.p.m. Motors. Price $575 each.

2—75-hp., 3-phase, 60-cycle, 220-volt Westinghouse, CCL, 685-r.p.m. Motors, complete. Price $750 each.

150-kw., 250-volt, D.C. C & C Elec. & Mfg. Co., type MPL, 6-pole compound wound, 500-r.p.m. Generator, complete with switchboard. Price $1250.

125-kw., 250-volt, D.C. Westinghouse, 6-pole, compound wound, 580-r.p.m. Generator, complete with switchboard. Price $1400.

2—75-kw., 250-volt, D.C. Crocker-Wheeler, 200-r.p.m. Generators, direct connected to Alberger Gas Engines. Price $4000.

25-kw., 250-volt, D.C., Crocker-Wheeler Generator, 300-r.p.m., direct connected to Alberger Gas Engine, with switchboard. Price $1000.

35-kw., 125-volt, D.C. General Electric-Curtis Turbo Generator, 3600-r.p.m., 125-lb. ST. Price $1000.

MOTOR GENERATOR SET

250-kw., 125/250-volt, D.C. Allis-Chalmers 2-phase, 25-cycle, 2300-volt Synchronous speed 750.

200-kw., 250-volt, D.C. General Electric, 3-phase, 25-cycle, 2300-volt Synchronous, speed 750.

2—200-kw., 250-volt, D.C. Allis-Chalmers, 3-phase, 25-cycle, 2300-volt, 750-r.p.m. Rotarys, with transformers.

200-kw., 250-volt, D.C. Westinghouse, 3-phase, 60-cycle, 2300-volt, 900-r.p.m. Synchronous Set.

3—150-kw., 250-volt, D.C. General Electric 3-phase, 60-cycle, 2300-volt, 1200-r.p.m. Synchronous Set.

100-kw., 250-volt, D.C. Westinghouse, 3-phase, 60-cycle, 2300-volt, 1200-r.p.m. Synchronous Set.

100-kw., 600-volt, D.C. General Electric, 3-phase, 60-cycle, 2300-volt Rotary, with transformers.

100-kw., 500-volt, D.C. Allis-Chalmers, 3-phase, 60-cycle, 2300-volt, 1200-r.p.m. Synchronous Set.

75-kw., 250 volt, D.C. Crocker-Wheeler, 3-phase, 60-cycle, 2300-volt, 720-r.p.m. Induction Set.

75-kw., 250-volt, D.C. Westinghouse, 3-phase, 60-cycle, 220-volt, 900-r.p.m. Synchronous Set.

50-kw., 250-volt, D.C. General Electric, 3-phase, 60-cycle, 220-volt, 1200-r.p.m. Synchronous Set.

25-kw. 220-volt, D.C. General Electric, 3-phase, 60-cycle, 2300-volt, 1200-r.p.m. Induction Set.

10-kw., 250-volt, D.C. Watson, 3-phase, 60-cycle, 220-volt, 1200-r.p.m. Induction Set.

7½-kw., 220-volt, D.C. Western Electric, 3-phase, 60-cycle, 220-volt, 1800-r.p.m. Induction Set.

7½-kw., 125-volt, D.C. Westinghouse, 3-phase, 60-cycle, 220-volt, 1200-r.p.m. Induction Set.

2—2½-kva., 1-phase, 60-cycle, 110-volt Crocker-Wheeler, 125-volt, D.C., 1800-r.p.m. Motor Generators.

2—2½-kw., 125-volt, D.C. Crocker-Wheeler, 500-volt, D.C., 1800-r.p.m. Motor Generators.

½-kw., 125-volt, D.C. General Electric, 1-phase, 60-cycle, 220-volt, 1800-r.p.m. Motor Generator.

25-amp., 8-volt, D.C. Westinghouse, 3-phase, 60-cycle, 220-volt, 1700-r.p.m. Induction Set.

25-amp., 28-volt, D.C. Westinghouse, 3-phase, 60-cycle, 220-volt, 1700-r.p.m., Induction Set.

10-kw., 60-volt, D.C. Northern, 125-volt, D.C., 835-r.p.m. Booster Set.

3-PHASE, 25-CYCLE MOTORS

Hp.	Make	Type	Speed
3	Westinghouse	CS	1400
15	General Electric	I.M., 2300-volt Slip Ring	750
20	Allis-Chalmers	AN	750
2—35	Allis-Chalmers	ANY 2300-volt Slip Ring	720
35	General Electric	IK	500
35	Westinghouse	CS	720
37	General Electric	"ITC" Slip Ring	685
3—52	General Electric	"ITC" Slip Ring	685

ALTERNATING CURRENT GENERATORS

30-kva., 3-phase, 60-cycle, 220-volt Burke, speed 1200-r.p.m.

30-kva., 3-phase, 25-cycle, 220-volt Westinghouse, speed 750-r.p.m.

50-kva., 2-phase, 60-cycle, 240-volt Burke, speed 1200-r.p.m.

50-kva., 3-phase, 60-cycle, 220-volt Burke, speed 1200-r.p.m.

50-kva., 3-phase, 60-cycle, 2300-volt, General Electric, speed 1200-r.p.m.

100-kva., 3-phase, 60-cycle, 220-volt Westinghouse, speed 900-r.p.m.

250-kw., 3-phase, 60-cycle, 220-volt Westinghouse speed 450-r.p.m.

350-kva., 3-phase, 25-cycle, 2300-volt Allis-Chalmers, direct connected to Harrisburg Fleming Steam Engine.

220-250-VOLT, D.C. GENERATORS

Kw.	West		
15	Westinghouse	S	900
25	Crocker-Wheeler	CCM	300
42½	Sprague	SB	725
50	Crocker-Wheeler	Engine	275
75	Westinghouse	S	725
85	Westinghouse	S	725
100	General Electric	Engine	725
100	Triumph	MP	650
125	Westinghouse	MP	580
150	C & C Electric	MP6	500
200	Westinghouse	MP6	500
200	General Electric	Engine	200

SPECIAL NOTICE

Our large and varied stock of A.C. and D.C. Motors will be sold this month at greatly reduced prices.

PITTSBURGH'S ELECTRICAL CLEARING HOUSE

ESTABLISHED 1908

MILLER-OWEN ELECTRIC CO., Inc., LEXINGTON AVE. AND THOMAS BOULEVARD PITTSBURGH, PENNA.

We cordially invite inspection of our new Warehouse, Salesroom and Shop

MACHINERY BARGAINS

H. P.	60 CYCLE MOTORS	R. P. M.
100	General Electric	690
100	Burke	514
75	Westinghouse	870
75	General Electric	865
75	General Electric	720
75	Westinghouse	1120
50	Fairbanks-Morse	865
50	Allis-Chalmers	850
40	Allis-Chalmers	865
40	Crocker-Wheeler	1170
30	Westinghouse	1755
30	Westinghouse	680
30	Westinghouse	1120
30	General Electric	860
30	Fairbanks-Morse	900
25	Westinghouse slip ring	690
25	Westinghouse	1120
25	General Electric	1150
25	Allis-Chalmers	1150
25	General Electric	865
20	Wagner	1140
15	Western Electric	1160
15	General Electric	1800
15	Westinghouse	1160
15	Westinghouse back geared	1120
10	General Electric	1120
10	Westinghouse back geared	1120
7½	General Electric	1165
5	Diehl	1730
3	Robbins & Myer	1750

A. C. BELTED GENERATOR

75	2400	60 cy., 2 ph. Westinghouse

Kw.	Volts	GENERATING UNITS
200	250	D.C. Ridgeway
160 Kva.	220-440	60 Cycle, 3 phase, C-W, Straight L.
125	125-250	D.C. G. E.-Terry3-wire turbo generator
100	125-250	D.C., C-W-Terry, 3-wire turb generator
100	250	D.C. Ridgeway
100	125	D.C., G. E.-Ames
75	250	D.C., C.W. with Alberger gas engine
50	125	D.C., C-W-Ames
50	125	D.C. Ft. Wayne—Alfree
50	250	D.C., C. & C.—Payne
30	250	D.C., C. & C.—Payne
20	125	D.C.,G.E. Vertical Marine set

D. C. BELTED GENERATORS

250	250	Westinghouse
125	250	Western Electric
65	250	Crocker-Wheeler
50	250	General Electric
20	250	Eck
60	125	Fairbanks-Morse
55	125	Crocker-Wheeler
40	125	Eddy
28	125	Akron
25	125	Westinghouse

CORLISS ENGINES

20x48 Harris	375 H.P.	18x42 Fishkill	275 H.P.
16x42 Nagle	200 H.P.	14x36 Bass	150 H.P
12x30 Watts-Campbell	100 H.P.	10x24 Harris	60 H.P

1000 other machinery bargains. All machinery Rebuilt and Guaranteed.

WICKES MACHINERY CO., JERSEY CITY, N. J.

A No. 1 POWER APPARATUS *IMMEDIATE DELIVERY*

OIL ENGINE UNITS

1—650 Kw. Revolving Field E. T. Alternators, 60-cycle, 3-phase, 480-v., D. C. to Vertical Gas Engine.
2—300 Kw., 60-cycle, 3-phase, Revolving Field E. T. Alternators, D. C. to Vertical Diesel Engines.
1—400 Kva., 60-cycle, 3-phase, Revolving Field Alternator, D. C. to Horizontal Diesel Engine.
2—300 Kw., E. T. Revolving Field Alternators, 250-v., D. C. to Vertical Diesel Engines.
SEVERAL BELTED GAS AND CRUDE OIL ENGINES RANGING IN SIZE FROM 100 TO 800 KW.

BOILERS

2—665 hp. B. & W. Steel Header, Butt Joint, 200 lb. pressure. With Superheaters and Jones Stokers.
2—500 hp. B. & W. Steel Header, Butt Joint, 185 lb. pressure, with B. & W. Stokers.
2—500 hp. Keeler, Heinie type, Steel Header, Butt Jointed, 160 lb. with Superheater.
2—400 hp. Keeler, Heinie type, Steel Header, Butt Jointed, 160 lb. with Superheater.
2—250 hp. Keeler, Heinie type, Steel Header, Butt Jointed, 160 lb.
1—400 hp. Stirling, 160 lb. Butt Joint construction, with Superheater and Stack.
3—250 hp. B. & W. Steel Header, Butt Joint, with Oil Furnaces.
1—600 hp. B. & W., 115-150 lb. Hand Fired.
1—500 hp. B. & W., 115-150 lb. Hand Fired.
1—400 hp. B. & W., 115-150 lb. Hand Fired.
1—250 hp. B. & W., 115-150 lb. Hand Fired.
3—250 hp. Heinie, 115-140 lb. Complete plant including Heater, Pumps, Piping and all Fittings.

TURBINES

2—1250-1800 Kw. Westinghouse Condensing or Non-Condensing or Bleeder type, 60-cycle, 3-phase, 480, 2300 or 11000-v.
1—9300 Kva. Westinghouse Horizontal Condensing, 60-cycle 3-phase.
1—1200 Kw., 1500 Kva. Allis-Chalmers, 60-cycle, 3-phase, 2300-v., 1800 rpm., Condensing type, complete with Jet Condenser and all Fittings.
2—2000-3000 Kw., G. E. Curtis Vertical Condensing, 25-cycle, 3-phase, 2300-v. with Surface Condensers and all Fittings and Accessories for complete plant.

MOTORS

1—500 hp. Westinghouse, C. W., 60-cycle, 3-phase, 440-v., 435 rpm., 2 Bearing Motor, complete.
1—1200 hp. G. E., 60-cycle, 3-phase, 2300-v., 260 rpm., Synchronous Damper Wound Motor with Starting Device. No Bearings.
1—1200 hp. G. E. Synchronous, 60-cycle, 3-phase, 2300-v., 450 rpm., 3 Bearing.
1—1200 hp. G. E., 25-cycle, 3-phase, 6600-v., 450 rpm., 3 Bearing.
1—1200 hp. G. E., 25-cycle, 3-phase, 2200-v., 250 rpm., Induction, 2 Bearing, with Shaft Extension both ends.

A. C. UNITS

1—200 Kw. G. E., 60-cycle, 3-phase, 2300-v., D. C., to Tandem Compound Automatic Engine, 150 rpm., complete.
1—400 Kw. Westinghouse, 60-cycle, 2- or 3-phase, 2200-v., D. C. to Cross Compound 4-valve Engine, 150 rpm.
1—400 Kw. Crocker-Wheeler Revolving Field Engine type Alternator, 60-cycle, 3-phase, 220-440-v., 225 rpm. No Engine.
2—300 Kw. Westinghouse R. F., Engine type Alternators, 25-30-cycle, 3-phase, 400-440-v., D. C. to Cross Compound Allis Corliss Engine.
1—300 Kw., G. E., 60-cycle, 3-phase, Alternator, 2300-v., D. C. at 150 rpm. to Tandem Automatic Engine.
1—325 Kva. Revolving Field, E. T. Alternator only, 60-cycle, 3-phase, 2300-v., 164 rpm.
1—650 Kw., Revolving Field, E. T. Alternator only, 60-cycle, 3-phase, 480-v., for direct connection at 170 rpm.

ENGINES

1—250 hp. Ideal Tandem Compound, 14 and 22 x 16 Automatic.
2—26 x 48 Hamilton Girder Frame Corliss, Wheel 20-ft. x 41-in.
1—22 x 48 Harris Left Hand Corliss. Wheel 16-ft. x 32-in.
HEAVY DUTY CORLISS, AUTOMATIC AND FOUR VALVE ENGINES, RANGING IN SIZES FROM 100 TO 1500 HP. CAPACITY.

BELTED D. C. UNITS

2—400 Kw., 250-v., M. P., 3 Bearing Westinghouse Generators; 375 rpm., with suitable Corliss Engines.
150, 200, 250 and 300 Kw. BELTED MULTIPOLAR GENERATORS WITH OR WITHOUT CORLISS OR AUTOMATIC ENGINES.

CONDENSERS

2—8000 Sq. Ft. Wheeler, Admiralty type, Surface Condensers, without Auxiliaries.
2—6750 Sq. Ft. Worthington, complete with all Fittings and Auxiliaries.
1—5900 Sq. Ft. Wheeler Surface with all Fittings and Accessories.
1—5000 Sq. Ft. Wheeler, complete with all Fittings.
1—4200 Sq. Ft. Alberger type, with Auxiliaries.
1—877 Sq. Ft. Wheeler, complete.

HEATERS

1—3000 hp. Cochrane Feed Water and Purifier.
1—1200 hp. Cochrane Feed Water and Purifier.
2—600 hp. Enclosed Brass Tube Vertical Heaters, complete with Brass Lined Feed Water Pumps.

PAUL STEWART & COMPANY, First National Bank Bldg., Cincinnati, Ohio

UNUSUAL OFFERING OF

BOILERS

TAKEN OVER FROM DU PONT POWDER CO'S PLANTS

Used from Six Months to Three Years and

PRACTICALLY AS GOOD AS NEW

I am in a position to make contracts, at very attractive figures, to install these boilers, ready for service. Every boiler guaranteed. Write or wire for prices.

Write me when you have Boilers and other power plant equipment for sale.

J. F. DAVIS

1122-1123-1124 HARRIS TRUST BLDG., CHICAGO, ILL.

AUCTION SALE—Surplus Government Property

U. S. GOVERNMENT WAREHOUSE, NO. 193, REMINGTON ARMS (U. M. C. PLANT)
SEAVIEW AVE., BRIDGEPORT, CONN.

Monday and Tuesday, January 5 and 6, 1920, at 10 A. M.

MISCELLANEOUS MATERIAL

BOLTS (Assorted Sizes)
BRONZE (Scrap)
CONCRETE TIE RODS
ENVELOPES
MANILA PAPER
MACHINE STEEL (Miscellaneous)
NUTS (Assorted Sizes)
OILS (Lubricating)
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PAINTS
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SHIPPING TAGS
SCREWS (Assorted Sizes)
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WIRE NETTING
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MISCELLANEOUS FACTORY EQUIPMENT, Including following various types of machinery, etc.

ACETYLENE GENERATORS
BLOWERS
DRILLS
FURNACES
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LATHES
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PULLEYS
PROFILERS
SAWS
SAND BLAST FURNACES
SHAVING MACHINES
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SODA KETTLES
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In addition to which the following factory furnishings:

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CHAIRS
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HOSPITAL EQUIPMENT
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TABLES

There will also be offered for sale the following Automobiles and Trucks
TWO OVERLAND FIVE PASSENGER TOURING CARS, MODEL 1916.
TWO FIVE-TON (Dump Body) PIERCE ARROW TRUCKS, MODEL 1916.
ONE ONE-TON (Band Body) MAXWELL TRUCK, MODEL 1918.

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A.C., 3-Phase, 60-Cycle, 220, 440-Volt, Electric Motors

100—¼-hp. 1700 r.p.m.	$ 13.75 each	15—5-hp. 1200 r.p.m.	$105.00 each
60—¼-hp. 1200 r.p.m.	17.75 "	3—7½-hp. 1200 r.p.m.	140.00 "
32—½-hp. 1200 r.p.m.	26.50 "	4—7½-hp. 1700 r.p.m.	120.00 "
30—¾-hp. 1700 r.p.m.	32 50 "	5—10-hp. 1700 r.p.m.	140.00 "
10—1-h.p. 1700 r.p.m.	38.75 "	5—10-hp. 1200 r.p.m.	160.00 "
2-h.p. 1160 r.p.m.	66.75 "	2—10-hp. 850 r.p.m.	195.00 "
4—2-hp. 1700 r.p.m.	52 00 "	4—15-hp. 1200 r.p.m.	190.00 "
3-h.p. 1200 r.p.m.	74.50 "	3—20-hp. 1200 r.p.m.	245.00 "
18—3-hp. 1700 r.p.m.	59.00 "	5—25-hp. 1200 r.p.m.	280.00 "
10—5-h.p. 1700 r.p.m.	77.50 "	8—35-hp. 900 r.p.m.	365.00 "
		4—50-hp. 900 r.p.m.	435.00 "

All above in G. E. Whse., Allis-Chal., Fairbanks-Morse, Crocker-Wheeler, Wagner, etc., etc. Compensators extra. All brand new, used 4 months, and remember, GUARANTEED for ONE YEAR. Other sizes in proportion, A.C. or D.C. Largest stock of its kind in America. Some can be reconnected to 2-phase.

NATHAN KLEIN & CO.

MOTORS HOWARD & CENTRE STS., N.Y. DYNAMOS

MOTORS FOR SALE

DIRECT CURRENT, 220 VOLTS

Qu.	HP.	Make	R.P.M.	Type	Windings
8	5	Lincoln	700-1200		Interpole
6	5	Holtzer-Cabot	1000		Compound wd., fully encl.
3	7½	Holtzer-Cabot	1000		
4	10	Holtzer-Cabot	800		
2	15	General Electric	750	CE	Compound wound
1	20	Sprague	650	D	
1	20	Lincoln	500-1500		Compound Interpole
1	25	Bullock	1350		
1	30	Holtzer-Cabot	1200		Fully enclosed
1	50	Crocker-Wheeler	950	CM	
1	150	Burke	1100-1300		Interpole

ALTERNATING CURRENT, 220 VOLTS

Qu.	HP.	Make	R.P.M	Ph	Cy
3	2	Crocker-Wheeler	1800	3	60
3	3	Crocker-Wheeler	1800	3	60
5	5	Crocker-Wheeler	1800	3	60
2	5	General Electric	1800	3	60
2	5	General Electric	1200	3	60
2	7½	Crocker-Wheeler	1800	3	60
2	7½	Westinghouse	1120	2	60
1	10	Wagner	1200	1	60
2	15	*General Electric	1200	2	60
1	10	*General Electric	1200	2	60
1	25	Westinghouse	1120	2	60
1	25	General Electric	1200	3	60
1	30	Allis-Chalmers	900	3	60
1	50	Allis-Chalmers	900	3	60

Form L

25 CYCLES, 440 VOLTS

Qu.	HP.	Make	R.P.M.
1	1	General Electric	1550
1	5	General Electric	1550
1	50	General Electric	750

1—10 Kw. Crocker-Wheeler Marine Set, 125 Volt, direct connected to a vertical engine. 18-inch, 24-inch, 30-inch and 36-inch D.C. and A.C. Exhaust Fans, motor driven.

We carry a large stock of smaller sizes DC. 110, 220 and 550 Volt Also several larger sizes

Monarch Electric Motor Co.

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GENERATORS and MOTORS

1—125 Kva. Allis-Chalmers Gen. 2400-v., 3-phase, 60-cycle, direct connected to Brownell Auto. Engine, complete with switchboard.
1—150 Kw. Triumph 250-v. D. C. Gen., direct connected to 16-in. x 21-in. Cluss Corliss Valve Engine.
1—150 hp. Fairbanks-Morse, 440-v., 3-phase, 60-cycle.
1—20 hp. G. E. 220-v., 3-phase, 60-cycle.
1—20 hp. Fairbanks-Morse, 220-v., 3-phase, 60-cycle.
1—200 hp. Crocker-Wheeler, 150-v., D. C.
1—75 hp. G. E., 440-v., 3-phase, 60-cycle.
3—50 hp. G. E., 440-v., 3-phase, 60-cycle.
3—40 hp. G. E., 440-v., 3-phase, 60-cycle.
2—25 hp. G. E., 440-v., 3-phase, 60-cycle.
2—15 hp. Westinghouse, 220-v., 3-phase, 60-cycle.
2—5 hp. Fairbanks-Morse, 220-v., 3-phase, 60-cycle.

POWER PUMPS (Belt Driven)

1—7-in. x 8-in. Gould's Vertical Triplex, 250 Gallon Cap.
1—5-in. x 6-in. Deming Vertical Triplex, 100 Gallon Cap.
1—6-in. x 6-in. Gould's Pyramid type, 75 Gallon Cap.
1—1500 lb. Pressure 1-in. x 4½-in. Vertical Triplex Hydraulic Pump.

CONVERTERS and TRANSFORMERS

1—300 Kw. G. E. Rotary Converter, 25-cycle, 600-v.
3—100 Kw. G. E. Transformers, 25-cycle, 13200 to 185-v. Oil cooled.
3—200 Kw. Westinghouse Transformers 25-cycle, 11500 to 440-v. Oil cooled, complete with panel and all instruments.

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10,000 ft. 400,000 C. M. Stranded Bare Copper Wire.
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10,000 ft. of No. 4-0 Grovel Copper Trolley Wire.

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165-hp. Crocker-Wheeler, type CCM, Interpole, 670 r.p.m.
90-hp. Westinghouse, type M, 650 r.p.m.
50-hp. Westinghouse, type M, 675 r.p.m.
45-hp. Diehl Interpole 600 r.p.m.
40-hp. Allis-Chalmers, 550 r.p.m.
25-hp. Westinghouse type SK, Interpole, 950 r.p.m.
25-hp. Bullock, 775 r.p.m.
15-hp. General Electric, type CE, 1200 r.p.m.
15-hp. Bullock, 1300 r.p.m.
15-hp. Peerless, 1150 r.p.m.
10-hp. Allis-Chalmers, 1300 r.p.m.
7½-hp. Crocker-Wheeler, 1100 r.p.m.
7½-hp. General Electric, 1600 r.p.m.

DIRECT-CURRENT MOTORS
110-125 VOLTS

50-hp. Bullock, 850 r.p.m.
32-hp. Crocker-Wheeler, type CCM, 1000 r.p.m.
30-hp. Kinetic, 1100 r.p.m.
25-hp. Crocker-Wheeler, type CCM, 750 r.p.m.
20-hp. General Electric, type CQ, 925 r.p.m.
20-hp. General Electric, type CQ, 1150 r.p.m.
15-hp. Crocker-Wheeler, type CCM, 800 r.p.m.
15-hp. Bullock, 1350 r.p.m.
2—10-hp. General Electric, type RC, Interpole, 850 r.p.m.
4—10-hp. Crocker-Wheeler, type CCM, 825 r.p.m.
7½-hp. Crocker-Wheeler, 1100 r.p.m.
7½-hp. General Electric, type CE, 1800 r.p.m.

Large stock of Alternating and Direct Current Motors. Immediate shipment.

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SLIP RING MOTORS

IMMEDIATE DELIVERY

220-440 volt, 3 ph., 60 cy. BRAND NEW G. E. Sliprings.
1—200-hp., 600 r.p.m., Constant speed, drum control.
1—150-hp., 720 r.p.m., Constant speed, drum control.
1—150-hp., 600 r.p.m., Constant speed, drum control.
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1— 75-hp., 900 r.p.m., Constant speed, drum control.
1— 75-hp., 720 r.p.m., Varying speed, drum control.
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2— 10-hp., 1800 r.p.m., Constant speed, drum control.
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220-440 3/60 NEW G. E. Squirrel cage complete

1—200-hp., 600 r.p.m.
1—150-hp., 720 r.p.m.
1—100-hp., 720 r.p.m.
3— 75-hp., 900 r.p.m.
1— 75-hp., 720 r.p.m.
2— 50-hp., 900 r.p.m.
1— 50-hp., 1200 r.p.m.
4— 40-hp., 900 r.p.m.
4— 40-hp., 1200 r.p.m.
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2— 30-hp., 1200 r.p.m.
6— 25-hp., 1200 r.p.m.
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All sizes and speeds 1 to 20-hp. in stock.

TWENTY FIVE CYCLE MOTORS
3 phase (NEW)

1—100-hp., 750 r.p.m., 2200 volts.
2— 50-hp., 750 r.p.m. 440 volts.
1— 50-hp., 750 r.p.m., 2200 volts.
2— 40-hp., 750 r.p.m., 440 volts.
2— 30-hp., 750 r.p.m., 220-440 volts.
3— 20-hp., 750 r.p.m., 220-440 volts.
1— 15-hp., 750 r.p.m., 220-440 volts.
5— 10-hp., 750 r.p.m., 220-440 volts.

1—150-k.w. (new) General Electric, type MPC, 250-275-volt motor generator set, 440-volt, 3-ph., 60-cy., 1200 r.p.m. on motor side. Complete with switchboard.

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607 Wabash Bldg., Pittsburgh, Pa.

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WE HAVE FOR IMMEDIATE DELIVERY

3 Phase, 220-440 and 2300 volt motors.

1—1500-hp. Westinghouse, 234 r.p.m.
1—1400-hp. Westinghouse, 505 r.p.m.
1—700-hp. Westinghouse, 502 r.p.m.
1—600-hp. Westinghouse, 440 r.p.m.
1—500-hp. Lincoln.
1—400-hp. Allis-Chalmers, 440 r.p.m., Slip Ring.
1—300-hp. Westinghouse, type CS, 580 r.p.m.
1—250-hp. Allis-Chalmers, 440 r.p.m., Slip Ring.
2—100-hp. Crocker Wheeler, Slip Ring, 720 r.p.m.
We have a large stock of smaller sizes, 1, 2 and 3-phase.

Air Compressors

1—Ingersoll-Sargeant Duplex Compressor, 2-stage air, 1154 cu.ft.
1—Ingersoll-Sargeant Straight Line, 2-stage air, steam driven, 1503 cu.ft.
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1—Hall cross compound, compound air and compound steam, 1700 cu.ft.
1—18 x 18 Laidlaw Dunn-Gordon Duplex, 30 lb. pressure, 1050 cu.ft.

Direct-Connected Units

110 VOLT, D.C., 250 VOLT, D.C. AND 500 VOLT, D.C. 220, 440 and 2200 Volt A.C.

GAS ENGINES, BOILERS, PUMPS AND HEATERS.

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STEAM ENGINES

2—125-hp. 13 x 13 Harrisburg.
1—215 hp. 14 x 16 Ames.
1—210-hp. 16 x 14 Ball.

MOTOR GENERATOR

1—Synchronous Motor Generator Set consisting of 700 hp. Synchronous Motor, Type ATI, 25-cycle, 13,000-volt, 750 r.p.m., Form C, and 1 A. C. 500-kw., Type ATB, 60-cycle, 4000-volt, and direct current exciter type M.P., 125-volt. Three units mounted on one shaft with two bearings.

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1—Hill 2-in. double suction Centrifugal Pump, with extended base. Capacity 75 G.P.M. against 125-ft. head.

NEW WESTINGHOUSE TRANSFORMERS

6—100-kva. Type S.C., 13,200-v. H.T., with 4—2½ H.T. Taps, 460 v., L. T. Single-phase, 25-cycle.
3—200-kva. Type S.C., 13,200-v. H.T., 2—5% Taps, 1-phase, 25-cycle, 460-230-v. L. T.
3—833-kva. O. I. S. C., 13,200-v. H. T., 4—2½% Taps, 1-phase, 25-cycle, L. T., 440-volts.

MISCELLANEOUS

1—New York Air Brake Compressor No. 2145 for 90 lb. pressure. Compressor end double action 7 in. x 9 in. delivering approximately 40 C. F. Air at 60 lb. pressure.
1—Patterson Automatic Steam damper regulator complete with brackets and weights.
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HAROLD R. WILSON MACHINERY CO.

Electric and Steam Machinery Second Hand

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DIRECT CONNECTED A.C. UNITS (60 CYCLES)

Kw.	Make	Volts	Ph.	Engine Description
8000	G. E.	2300	3	Westge. Hor. St. Turb.
2500	G. E.	2300	3	Curtis Horizontal Steam Turbine
1000	Westge.	2300	2 or 3	Allis C.C. Corliss Engine
850	Allis	2300	3	30x48 Allis Corliss
675	G. E.	480	3	26x33 Horizontal Ball Cor.
500	Allis	2300	3	24x42 Allis Corliss
3— 300	Allis	480	3	Allis Hor. Non-Cond. Turbine
300	G. E.	2300	2 or 3	14&30x42 Cross Compound
250	Westge.	2300	3	Westinghouse Hor. Steam Turbine
240	G. E.	2300	2 or 3	18x30 Buckeye
200	G. E.	2200	3	McIntyre & Seymour, 4-valve
187	Westge.	2300	3	Westinghouse-Parsons Steam Turbine
150	G. E.	2300	3	14 & 22x16 Ideal Tand.
150	Ft. Wa.	2200	3	14 and 22x19 Chuse 4-valve
125	Ft. Wa.	2200	3	16x16 Chuse
2— 100	G. E.	2300	3	to Curtis Turb., 1 Cond., 1 Non-Cond.
100	G. E.	220	3	14x18 McIntyre & Seymour
75	Burke	2200	3	Simple Skinner Engines
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We probably have just what you require—Try us.

Immediate MOTORS *Delivery*

A Few Selections From Our Large Stock
CORRECT PRICES AND PROMPT SERVICE

Quan.	Make	Hp.	Type	Ph.	Volt	R.p.m.	Cy.	Condition
1	Allis-Chalmers	15	.....	2	220	1200	60	Good
1	Westinghouse	15	CS	2	220	1200	60	Good
2	Westinghouse	25	CS	2	220	1200	60	New
1	Wagner	25	BR	2	220	1140	60	Good slip rg.
1	Allis-Chalmers	30	3K	2	220	860	60	Good
1	Crocker-Wheeler	7½	114Q	3	220	1130	60	New slip rg.
1	Crocker-Wheeler	10	114Q	3	220	1710	60	New slip rg.
1	Allis-Chalmers	10	B	3	220	1200	60	Good slip rg.
2	Westinghouse	15	KT	3	220	1200	60	New
1	Crocker-Wheeler	15	118Q	3	220	675	60	New
1	Crocker-Wheeler	15	KT	3	220	900	60	Good
1	Westinghouse	20	CS	3	220	900	60	Good
1	Westinghouse	20	CS	3	220	1200	60	Good
1	Crocker-Wheeler	20	116Q	3	440	1720	60	New
1	General Electric	20	I	3	220	1200	60	Good
1	Western Electric	20	KT	3	220	900	60	New
1	Crocker-Wheeler	25	25R	3	440	720	25	New
1	Westinghouse	25	CS	3	220	1160	60	New
1	Westinghouse	30	CS	3	220	870	60	New
1	Crocker-Wheeler	35	118Q	3	220	1750	60	New s lip rg.

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General Electric Frequency Changer

One 2-unit, 4-bearings, 60 to 25 cycle, 3-phase Frequency Changer, 60 cycle unit, 9500 k.w., 13,800 volts, 25 cycle unit, 9000 k.w., 13,800 volts. Speed 300 r.p.m. Machines are mounted on a common base.

Machine will be sold with complete switching and instrument equipment, motor operated field rheostats, and complete auto-transformer starting equipment, including pressure oil pumping apparatus for use when starting the set. Machine has had little use and is in excellent condition. Detailed information will be furnished on application to

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2 WESTINGHOUSE TURBO GENERATORS

1—625-kva. 1—780-kva., 60 cycle, 3 phase, 2300 v.
2—Westinghouse LeBlanc low level jet condensers with turbine drive.

2 WESTINGHOUSE EXCITERS

1—Turbine drive. 1—Motor drive.

Boilers, Heaters, Pumps, Piping, Switchboards, etc.

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DIRECT CONNECTED UNITS

35-kw., 120 volts, D.C. Generator to De Laval Steam Turbine, 70 lb.
3½-kw. Generator, 125 volts, 400 r.p.m. to 6-hp. Fairbanks-Morse Engine, Gas or Gasoline.

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50-hp. Triumph, 685 r.p.m., complete.
35-hp. C. S. Westinghouse, 1120 r.p.m., complete.
15-hp. Gen. Electric, 900 r.p.m., complete.
15-hp. C. S. Westinghouse, 900 r.p.m., complete.
20-hp. C. S. Westinghouse, 900 r.p.m., complete.
20-hp. F. Westinghouse, Slip Ring, 720 r.p.m., with drum type controller.

D. C. MOTORS

40-hp. SK Westinghouse, 600-1200 r.p.m.
115-hp. DLC Gen. Elec., 975 r.p.m.
20-hp. CE Gen. Elec., 1120 r.p.m.
15-hp. CVC Gen. Elec., 825 r.p.m.
We have a complete stock of A.C. and D.C. Motors on hand, in sizes from 1 hp. to 150 hp.

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Steam Engine Generator Sets

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1—100-Kw., 250-v., Western Elec., Gen. direct connected to 1—16 x 14 Erie City engine, with switchboard.
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1—Complete boiler plant, consisting of 4 300-hp. Sterling boilers, with stacks, ash conveyors and Westinghouse stokers.
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1—8-ton 36-in. gauge Porter locomotive.

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FIRST-CLASS USED EQUIPMENT

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1—2000-2500-kw. G. E., 1800 r.p.m., 150-lb. pressure, 3-ph., 60-cy., 2300-volt horizontal **Steam Turbo Generator**—6000 sq.ft. C. H. Wheeler surface condenser, with engine driven aux.
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1—200 GPM 3-in. Jeansville-Terry cent. D. S. **Pump.**
1—9-in. x 6-in. x 12-in. duplex, outside, center packed **Blake Pump.**
1—20-kw. G. E., 900 r.p.m., 2300-volt, motor driven, 125-volt **Exciter.**
1—**G. E. Tirrell Regulator,** 2886-TA-125-F-6, mounted on 16 x 31 x 1½ inches, black slate.

Greenfield Electric Light & Power Co.

Greenfield, Mass.

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AULTMAN & TAYLOR BOILERS

Heating surface 3176 sq. ft., 144 tubes length 18 ft., diam. 4 in., 2 steam drums length 23 in. 3⅝ in., diam. 36 in. $10 per H.P. f.o.b. cars; subject to prior sale. Inspected and passed at 155 lbs. pressure—320 H.P. each.

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ELECTRIC ARC-WELDING OUTFITS—NEW

10—150 ampere and 1—600 ampere sets, direct connected to D.C. 230-v. motors. All sets brand new and complete with panels, mounted on trucks. 600 ampere set has 3 panels.

PANELS—NEW

25—Panels (new) complete, with instruments for rotary converters.

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1—30 hp. D.C., 230 v., 240 r.p.m.

Full Stock of A. C. or D. C. Motors Always on Hand.

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MOTORS - DYNAMOS

Write us what you want to buy or sell

SCHWARTZ & LAND
207 Centre Street **New York**

Special on Large Slip Ring Motors

2—100 H.P. 440-volt, 3-phase, 60-cycle, 900 r.pm., slip-ring motors complete with multiple switch control and grids. Price $1200 each.
4—75 H.P. 440-volt, 3-phase, 60-cycle, 900 r.p.m., slip-ring motors complete with multiple switch control and grids. Price $950 each.
Two 75 H.P. are Crocker-Wheeler and two Allis-Chalmers, one 100 H.P. is Crocker-Wheeler and one Allis-Chalmers. Apparatus is new.

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MOTORS—DYNAMOS

10—35 HP. West. 440-V., 3-ph. Motors.
15—40 HP. West. 440-V., 3-ph. Motors.
4—50 HP. G. E. 440-V., 3-ph. Motors.
10—7½ HP. West. back geared, 3-ph., Motors.
1—75 HP. West. C. S. 220-V., 25-cyc. Motor.

Large stock of 3-phase motors at unheard of low prices.

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MOTORS

Complete line of A.C. and D.C. Motors in Stock

1—Terry Turbine, 150 lb., steam direct connected to two 100 kw. Crocker-Wheeler generators, D.C., 250 volts, 2200 r.p.m.
1—2½ Kw., 125 v. Sprague Electric, Direct Connected to Meitz & Weiss oil engine.

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D. S. HOLCOMB, 241-243 Canal St., New York

1200 H. P. MOTOR

General Electric, 25-cycle, 3 phase, 2300 Volt, 250 Revolutions, Motor with Control Panel and Controller.

Immediate Shipment

PAUL STEWART & CO.
First National Bank Building,
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25-Cycle Units

Immediate Delivery

SPECIAL BARGAIN

2—300 KW. Westinghouse, Engine Type Revolving Field Alternators, 25-Cycle, 3-Phase, 400 to 440 Volts. Direct Connected at speed of 107R.P.M. to Allis-Chalmers Cross Compound heavy duty Double Eccentric Modern type Corliss Engines. Condition practically new.

We offer the above for immediate shipment at a special sacrifice figure representing an unusual bargain.

PAUL STEWART AND COMPANY
Electrical and Steam Machinery
Cincinnati, Ohio.

FOR SALE

1—750 Kw. G. E. Curtis Vertical Turbine, 3-phase, 60-cycle, 2300-v.
2—500 Kw. G. E. Curtis Horizontal Turbine, 3-phase Condenser and switchboard.
1—300 Kw. Westinghouse vertical compound unit, 3-phase.
1—375 Kw. G. E. Minneapolis Corliss, 3-phase Condenser and Switchboard.
1—300 Kw. G. E. Quincy Corliss, 3-phase.
1—200 Kw. Westinghouse Ball Compound, 250-125 volts, D. C.
2—150 Kw. Jeffrey 250 volt Generators 19 x 18 McEwen Engine.
1—100 Kw. G. E. 125 Generator, direct connected to Harrisburg, 4-valve.
2—30 Kva. Westinghouse Single Phase 2400-1200-240-120.
1—25 Kva. G. E. Single Phase, 2200-1100-220-110.
1—16 x 16 Atlas Side Crank, Self Oiling Engine, like new.
1—17½ x 27 Buckeye Engine, 10-ft. x 24-in. hand wheel.

J. H. COCHRAN, Keller Bldg., Louisville, Ky.

Brand New Generating Units

For Immediate Shipment

1—180 Kva., 60 cycles, 3 phase, 2300 volts, Western Electric Alternator, directly connected to simple, non-releasing Corliss engine. With belted exciter. Immediate shipment.

1—312 Kva., 60 cycles, 3 phase, 2300 volts, 200 R.P.M., Western Electric Alternator, directly connected to simple, non-releasing Corliss engine. With belted exciter. Immediate shipment.

1—150 Kw., 250-275 volts, 200 R.P.M., General Electric, direct current Generator, directly connected to simple non-releasing Corliss engine. With standard switchboard. Immediate shipment.

2—200 Kw., 250-275 volts, 200 R.P.M., General Electric, direct current Generators, directly connected to simple, non-releasing Corliss engines. With standard switchboard. Immediate shipment.

1—75 Kw., 125-250 volts, 3 wire Western Electric, direct current Generator, directly connected to simple non-releasing Corliss engine. With 3 wire generator switchboard. Immediate shipment.

H. A. & G. X. CHUSE, Mattoon, Ill.

Immediate Delivery

STEAM TURBINES

60-cyclt, 3-phase
9375 Kva. 2300-v. Horizontal Westinghouse LeBlanc Condenser.
5000 Kva. 2300-v. Horizontal G. E. Condenser.
1250 Kva. 600-v. Allis Non-Condenser, 2300-v.
625 Kva. 480-240-v. Westg. Condenser Auxiliary.
2—187 Kva. Westg. and 1-125 Kva. G. E. 2300-v.
1560 Kva. 480-240-v. Allis Condenser Auxiliary.

DIRECT CURRENT TURBINES

15-20-75-100 Kw. Exciters, 125-v.
2—500 Kw. hor. G. E. 600-v. with Switchboard.
150 Kw. 125-250-v. 2-3 Wire Switchboard.

BOILERS

2—326-hp. hor. Water Tube, 180-lb. pressure.
1—517-hp. Sterling Hand Fired, 150-lb.
587-hp. Rust B. & W. Type, 150-lb.
2—276-hp. Sterling, 150-lb., with stack.
315-hp. Heine, 180-lb., with stack.
8—150-hp. HRT Boilers, stacks, 125-lb.
3—515-hp. U. I. W. Heine Type, 150-lb., 60-cycle, 3-phase, Generator.

BELTED A.C. 60-CY. 3-PH. GEN.

750 Kva. 360 Revolutions G. E. 3-bearing Exciter, 2300-v.
1—212 Kva-1-187, Kva-1-125, Kva-1-100, Kva. all 240-v.
1—100 Kva. 277 Revolutions, 2300-v.
1—250 Kva. 480-v., 230-v., 900 Revolutions.
1—150 Kva. 2200-v., 2-phase, 720 Revolutions.
1—150 Kva. 2300-v., 900 Revolutions, Westing.

ENGINE TYPE A.C. 60-CY. 3-PH.

1—NEW G. E. 675 Kva. 480-240-v. Engine Set 26-in. x 33-in., 4-valve engine.
100 Kva., 750 Kva., 625 Kva., 25-cycle, Eng. Sets
3—125 Kva. 2300-v. Engine Sets, 2300-v.
1—375 Kva. G. E. 2300-v. Tan. Com.
1—75 Kw. 240-v., 13 x 14 C. & T. Engine.
1—625 Kva. 2300-v. G. E. C. C.

CORLISS AND HIGH SPEED ENGINES

ROSS POWER EQUIP. CO.
L. D. Phone Main 7200 Indianapolis, Ind.

MOTORS

A.C., 3-ph., 60-cy., 440-v.

2-75 hp. 900 rpm. General Electric
2-75 hp. 800 rpm. Westinghouse
8-50 hp. 800 rpm. General Electric
1-45 hp. 1200 rpm. General Electric
9-40 hp. 1200 rpm. General Electric
8-35 hp. 1200 rpm. General Electric
5-25 hp. 1200 rpm. General Electric
6-25 hp. 1200 rpm. Westinghouse
4-20 hp. 1200 rpm. Westinghouse
9-15 hp. 1200 rpm. Westinghouse
7-10 hp. 1300 rpm. General Electric
4-10 hp. 1900 rpm. Westinghouse

All in first-class condition—immediate delivery.

L. F. SEYFERT'S SONS, Inc.
437 N. 3d Street, Philadelphia, Pa.

FOR SALE

Elaborate Equipment of Gravity and Power Conveyors

1—Duplex Pump, 16-in. x 12-in. x 10.
1—Duplex Pump, 12-in. x 8½ x 10.
2—Cook Pumps, 8 x 36.
1—10 x 10—50-hp. McEwing Engine.
1—35-kw., 115-volt, direct current Westinghouse Motor.

BAGBY-HOWE DRUG CO., INC.
503 W. Main St., Louisville, Ky.

Diesel Oil and Gas Engines, Generators, Motors

American Diesel Oil Engines

120 B.H.P. vertical 3-cy. belted.
170 B.H.P. vertical 3-cy. belted.
2—225 B.H.P. vertical 3-cy. belted.
2—450 B.H.P. vertical 3-cy. belted.
Each direct connected to 3-pr. 60-cy. a.c. generator.
150 B.H.P. single cy. 2-cy. semi-Diesel, direct connected to 125-Kva., 3-ph., 60-cy. 2200-v. generator.
100 B.H.P. vertical 2-cy. oil engine b. 80-H.P. horizontal 2-cy. semi-Diesel belted.
2—85-H.P. vertical 3-cy. oil, belted.
35-H.P. horizontal 2-cy. oil engine.
150-H.P. vertical gas engine, d.c. to 100-Kw., 220-v. D. C. generator.
100-H.P. vertical 3-cy. gas engine, d.c. to 55-Kw., 125/250-v., 3-wire generator.
100-H.P. vertical 3-cy. gas engine, direct connected to 65-Kw., 25-v. d.c. generator, belted.
85-Kva., 3-ph., 60-cy., 230-v. English type generator.
75-Kva., 3-ph., 60-cy., 230-v. English type generator.
200 G.P.M. Triplex pump, belted.
12,000-gallon horizontal oil storage tank.

ALL GUARANTEED IN FIRST-CLASS CONDITION.

A. McMILLAN
619 Monadnock Block, Chicago, Ill.
(Specialist in Diesel oil engineering.)

BRAND NEW

15 Electro-Dynamic variable speed, interpole motors, 5 H.P., 230 volts, 225/600 R.P.M.

HALF PRICE

E. N. GOODMAN
257 West 100th St.
New York City

BRAND NEW

ROTARY CONVERTER

60 kva. 60-cycle, 3-phase, 230-volts.
Very low price.

NATHAN KLEIN & CO.
Howard and Centre Sts., New York City.

PROMPT DELIVERY

VERTICAL ALTERNATORS & EXCITER

2—650-kva., 150-r.p.m., 48-pole, 2400-volt, 156 amperes, 60-cycle, 3-phase, vertical type Generators, complete with bases, shafts steady bearing and field rheostats.
1—50-kw., 450-r.p.m., 125-volt, vertical type exciter, complete with base, shaft, thrust bearing above and steady bearing below, and field rheostat.

For details and very attractive prices, write us.
The F. Bissell Co., Toledo, Ohio, U.S.A.

Power Plants—Equipped Complete

Rails—Locomotives—Cars
Tanks—Pipe—Piling, etc.

ZELNICKER IN ST. LOUIS

For Big Bargains Get Bulletin 270—60 pages. It's a sure money saver.

The City of Lethbridge, Alberta, Canada, have for sale

One Complete Electrical Unit

capacity 350 K.V.A. 2200/2300 V., 2-Phase, 60-Cycle, composed of Bellis & Morcom Compound Engine, Exciter on shaft, 440 B.H.P., 360 R.P.M., with 150 lbs. steam, 26 in. Vacuum, Condenser Motor driven circulating, and condensate pumps. Generator suitable for 3-phase winding.

In perfect condition and immediate delivery. Apply,

M. FREEMAN
Commissioner Public Utilities.

FOR SALE—NEW

McIntosh & Seymour No. 3 B24 Diesel type

OIL ENGINE

Capacity 150 b.hp. Arranged for direct connection to Westinghouse alternator, 125-kva., 277 r.p.m., 3-phase, 60-cycle, 220-volt engine type alternator, with damper windings and the usual accessories. 5-kw., 125-volt, 1120 r.p.m. belted exciter with rails, pulley and switchboard mounted field rheostat.

Ready for immediate shipment.

EQUIPMENT SALES CO., INC.
112 Ellison St., Cor. Main, Paterson, N. J.

SEARCHLIGHT SERVICE SECURES SATISFACTORY SALES

2004

FOR SALE

1—1000 Kw.
ALLIS-CHALMERS TURBO UNIT

1—1000 Kw.
HAMILTON WHEELER UNIT

1—500 Kw.
WESTINGHOUSE HARRISBURG UNIT

1—5000 Hp.
WESTINGHOUSE MOTOR
2-phase, 60-cycle, 440-volt

2—60 Hp.
WESTINGHOUSE SPEED MOTORS
D.C. Variable 90 to 400 R.p.m.

THE B. F. GOODRICH CO.
AKRON, OHIO.

Generating Units

Two—70 KW, 220-volt, 2-phase, 60-cycle, 277 rpm., revolving field, Westinghouse generators direct connected to 12 x 12 Ames engines, complete with exciters and switchboard panels.

In very fine condition.

GEORCE SACHSENMAIER CO.
926 N. Third St., Philadelphia, Pa.

30—X-Ray
Indirect Lighting Fixtures

complete with 30-inch drop-chain brushed-brass finish; wired all ready to hang. Cost $20 each, new; will take $5 each.

McGRAW-HILL COMPANY, INC.
10th Ave. at 36th St., New York City.

FOR SALE
27—Electric Units from 300 to 10,000 kw.
16—Hoists, Electric Cars and Locomotives.
20—Water Tube Boilers.

Get Our Lists and Prices

J. F. DONAHOO COMPANY
Birmingham, Ala.

FOR SALE

Slightly Used Steam Equipment

Due to the dismantling of our Switchback, W. Va., plant, we can save you money on the following equipment:

1—Westinghouse-Parsons, 2200-v., 3-phase, 60-cycle, **1300-Kva. Turbo Generator** (low pressure condensing), 1800 rpm., with all necessary switchboard, rheostats, oil switches and metering equipment.

2—**Worthington Condensers** for above connected to 168-nozzle spray pond with circulating water pump, etc.

4—480-hp. **Stirling Boilers,** manufactured by Babcock & Wilcox, 150-lb. pressure, complete with feed water pump, 14-in. x 8½-in. x 15-in. double stroke Worthington Pump, water heater, etc.

1—40-gal. **Platt Centrifugal Pump,** 290-ft. head, connected direct to 50-hp., 2200-volt motor, with compensator.

All the above items practically as good as new.

Upon application we will furnish more detailed list of Boilers, Turbines, Condensers, Spray System and miscellaneous equipment.

Apply to Purchasing Department,
APPALACHIAN POWER COMPANY,
Bluefield, W. Va.

POWER!

250 VOLT, D.C.

1—**500-kw. Westinghouse Generator,** 250-275-volt, direct current, direct connected with **Wetherill** Cross Compound Corliss Engine of the rolling mill, double eccentric type. Speed **90-r.p.m.**

1—**500-kw. Westinghouse Generator,** 250-275-volt, direct current, direct connected with **Hewes & Phillips** Cross Compound Corliss Engine Rolling Mill, double eccentric type, speed **90-r.p.m.**

Above two Units are equal to brand new and will be guaranteed as such. Unusually heavy, capable of 50 per cent. overload.

2—**540-kw.,** 3-wire, 125-250-volt, direct current **Generators,** with Cross Compound Engines.

1—**300-kw. Crocker-Wheeler Generator,** 250-volt, direct current, direct connected with Tandem Compound heavy duty Corliss Engine.

1—**100-kw. General Electric Generator,** 110-125-volt, direct current, direct connected with Compound Ball Engine.

Innumerable others, all sizes, 25 to 2000-kw.

A.C. UNITS

1—**1000-kw. Westinghouse Alternator,** 2- or 3-phase, 60-cycle, direct connected with Cross Compound, heavy duty Corliss Engine.

1—**600-kw. General Electric Alternator,** 3-phase, 60-cycle, 2300-volt, direct connected with **Rice & Sargeant** Cross Compound Corliss Engine.

1—**300-kw. General Electric Generator,** 2-phase, 60-cycle, 2300-volt, direct connected with Cross Compound Engine.

1—**100-kw. Western Electric Generator,** 3-phase, 60-cycle, 2300-volt, direct connected with Buckeye Tandem Compound Engine.

1—**150-kw. Stanley Belted Generator,** 2-phase, 60-cycle, 2300-volt.

1—**150-kva. General Electric Belted Generator,** 2-phase, 60-cycle, 480-volt.

CORLISS ENGINES!
50 to 2,500 H.P.
Simple or Compound.

TURBINES!
A.C. or D.C.

Complete Power Plants designed and erected

POWER EQUIPMENT CO.
Engineers
1809 Buttonwood Street, Philadelphia, Pa.

Generator Sets

1—250 and 1—300 K.W., 25-Cy. 3 Ph. McIntosh & Seymour cross compound engine generator sets complete. Used but a short time.

2—450 same in use four years.

1—600 KW. 60 Cy. 3 Ph. Engine Generator set new; all in first-class condition.

Located in the United States.

POWER PLANT EQUIPMENT CO.
310 Dominion Bank Bldg., Toronto, Canada

FOR SALE

110-Volt D.C.

ELECTRIC LIGHT PLANT

In town of 600, about 40 miles from Milwaukee.

F. J. SCHMIDT
624 28th St., Milwaukee, Wisconsin

FOR SALE

TWO BURKE WOUND ROTOR INDUCTION MOTORS
180 H. P., 2 Phase,
60 Cycle, 2200 Volts,
400 R. P. M., Type E. M. V. 65

These motors are three pedestal type equipped with pulley and rails.
Two SUNDH Automatic Starters for above motors.

Delivery: January, 1920

The above motors are in regular operation driving ice machines and may be inspected by appointment.
Offered for sale due to change in voltage supplied to consumer.

New York & Queens Electric Light and Power Company
Queens Plaza, Long Island City

EXCEPTIONAL BARGAINS

5 H.P. Variable slip ring, General Elec.
3 H.P. Variable slip ring, General Elec.
2 H.P. Variable slip ring, General Elec.

NATHAN KLEIN & CO.
Howard and Centre Sts., New York City.

NASH, 2-CYLINDER GASOLINE ENGINE

Vertical, direct connected to a 12½ Kw. C. & C. type S. 275 R.P.M., compound wound, 125 volt Generator.

Will sell at bargain price. Write

NATHAN KLEIN & CO.
Howard & Centre Sts., New York.

FOR SALE
100,000 No. 55 carbon

W. G. DRILLS

Make us an offer

FS514—Electrical World
1570 Old Colony Building, Chicago, Ill.

Quality Machinery
Never causes failures or regrets
We buy and sell only
The Best
What are your requirements
Geare & Co. Engineers
Old Colony Bldg. Chicago, Ill.

FOR EVERY BUSINESS WANT—

"Think
SEARCHLIGHT
First"

0108

SEARCHLIGHT SECTION

WIRING MOTORS
SIGN OF O B QUALITY
FIXTURES REPAIRS

When you see this sign, you will know it stands for best quality in workmanship and materials.

To be convinced send us your next repair job on Electric Motors or Generators. We also carry a large stock of new and used motors.

OLSON-BOETTGER ELEC. MFG. CO.
St. Paul, Minn.

BOUSTEAD
ELEC. & MFG. CO.

Switchboards

New and Used Electrical Machinery

Winding and Repairing

16-18 E. Hennepin Ave.
MINNEAPOLIS, MINN.

WORTH KNOWING

DID IT EVER OCCUR TO YOU that when your MOTORS and DYNAMOS go wrong it's worth money to you to know the right place to get them put in shape *promptly* and at the *right price?*

We manufacture DYNAMOS and MOTORS and also carry a line of USED MOTORS, including both Alternating and Direct Current.

THE HOLT ELECTRIC CO.
377-379 South Pierce St., Milwaukee, Wis.
Phone Hanover 519

WANTED

500 Kw. Turbo GENERATOR

Generator 2300 V. 3-phase, 60 cycles. Turbine 150 lb. Steam Pressure. Equipment must be in first class condition. Quote price and send complete data on all equipment including condenser, exciter, and switchboard.

Southern New York Power Co.
Cooperstown, N. Y.

WORRYLESS ELECTRICAL REPAIRS

On all kinds and sizes A.C. or D.C. motors and generators, starters, welders, controllers, or anything electrical. Quick shipment from stock material, of coils commutators—shafts—bearings, etc Remember our initials stand for our product.

CAREFUL CLEVELAND ACCURATE ARMATURE WORRYLESS WORKS, Inc.

EST. 1895 4732-4-6 ST. CLAIR AVE., CLEVELAND INC. 1918

ELECTRICAL REPAIR SERVICE

Denton Engineering & Construction Company
317-319 East 17th Street, Kansas City, Mo.

A Shop Equipped to Repair any Kind of Electrical Machinery

Platinum Wanted

We solicit small or large shipments of platinum in any shape or form. Individuals or companies may ship us. Send by mail or express from anywhere platinum wire, contact points, crucibles, sheet, foil, etc. Cash sent you by return registered mail. Goods held 5 to 18 days and returned if you're not satisfied. Satisfied customers in all parts of the world. We also buy old gold, silver and mercury, in any amount, shape or form. Small shippers given particular attention and just as prompt service. Any refining done on a time basis.

OHIO SMELTING & REFINING CO.
254 Lennox Bldg., Cleveland, Ohio

WANTED

1500 KW., 80% Power factor, 2300 volt, 2 phase Condenser type Turbo Generator, without condenser.

Must be of late type and good efficiency.

IOWA GAS & ELECTRIC CO.
Iowa City, Iowa

WANTED

TURBO GENERATOR SET

440-volt, 3-phase, 60-cycle, about 200 kva.

Must be mixed pressure. Give full particulars.

SWAYNE LUMBER COMPANY
Oroville, Calif.

WANTED

MOTOR GENERATOR SET

One 125 to 175-kw. synchronous, self-starting, self-exciting motor generator set, consisting of 2300-volt, three-phase, 60-cycle motor, and 230-volt direct current generator, together with switchboard consisting of motor and generator control panels with voltmeters, ammeters, switches, voltage transformers, current transformers, auto transformer for starting, and circuit breaker. Advise price, condition, how long in service, and where it may be inspected.

W 512 Electrical World, 935 Real Estate Trust Bldg., Philadelphia, Pa.

Keep your Eye
on the
Searchlight
and your
Advertisements in it

WANTED

FREQUENCY CHANGER AND MOTOR GENERATOR SETS

150-200 KW. D.C., 230 volt generator, connected 550 volt, 60 cycle, 3 phase, Synchronous Motor.

Two Frequency Changer Sets each approximately 300 KVA, 25 cycle, 3 phase, 41,000 volts and 2300 volts, 60 cycle, preferably 2 phase.

C. P. WILSON, 509 Lumsden, Toronto, Ontario, Canada

SEARCHLIGHT SECTION

Ads Set in Uniform Style

(Solid in one paragraph, without disply)

THREE CENTS A WORD, minimum charge 50 cents an insertion, payable in advance, less 10 per cent. if one payment is made in advance for four continuous insertions—for advertisements under:

Positions Wanted
Evening Work Wanted
Vacation Work Wanted
Salesman Wants Connections

FIVE CENTS A WORD, minimum charge $1.50 an insertion, for advertisement under:

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Agents Wanted
Business Opportunities
Desk Room for Rent
Educational
Employment Agencies
Desk Room Wanted
Foreign Business
Positions Vacant
Partner Wanted
Representations Wanted
Salesmen Wanted
Patents for Sale
Plants for Sale
Sub-Contracts Wanted
Work Wanted

Miscellaneous for Sale, for Rent or Want Ads.

THIRTY CENTS A LINE, minimum five lines, for all undisplayed advertisements set with a paragraph for each item or tabulated.

THREE DOLLARS AND SIXTY CENTS AN INCH for advertisements for bids (Official Proposals).

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(Individual space, within border rules)

Space for these advertisements is sold by the inch. Each page contains 30 inches. The rate per inch is based on the *total* number of inches to be used—that is, the number of inches the advertisement is to occupy multiplied by the number of insertions it is to receive. For instance, a 2-inch advertisement in 2 issues earns the 4-inch rate of $3.90 an inch. A 1-inch space for 4 issues, or a 4-inch space in one issue, also earn the 4-inch rate.

Schedule of Rates

1 to 3 in., $4.00 an in. 15 to 26 in., $3.70 an in.
4 to 7 in., 3.90 an in. 27 to 49 in., 3.60 an in.
8 to 14 in., 3.80 an in. 50 to 99 in., 3.50 an in.

Rates for larger space furnished on request.

In Replying to Ads

DO NOT ENCLOSE original testimonials or anything that you may want returned. State your experience and qualification in as concise and neat a manner as possible and enclose copies of your testimonials.

BE CAREFUL TO PUT ON ENVELOPE, when answering any "blind" ad, the box number in the ad, the name of the paper, and also the local address of office to which reply is sent:

36th St., at 10th Ave., New York
935 Real Estate Trust Bldg., Philadelphia
533 Leader-News Bldg., Cleveland
1570 Old Colony Bldg., Chicago
501 Rialto Bldg., San Francisco

When Writing Copy

ALLOW FIVE WORDS for the address, if replies are to a box number in care of any of our offices. There is no extra charge for forwarding replies.

TO SIGN YOUR NAME and address to your advertisement begets the confidence of the reader and facilitates receiving replies. You can, however, obviate delay in receiving answers by signing your ad. only with initials (your own or others), care of your home, your office or a post-office box number in your city.

POSITIONS VACANT — EMPLOYMENT — POSITIONS WANTED

FOR SALE

D.C. Generators For Sale

1-100 kw., 360 r.p.m., 125 volt, belted.
1-60 kw., 275 r.p.m., 125 volt, engine tp.
1-60 kw., 275 r.p.m., 250 volt, engine tp.
All General Electric, in excellent condition, for immediate delivery. V. N. Nussbaum & Co., Ft. Wayne, Ind.

60 Cycle, Three-Phase Motors For Sale

75-hp., 720 r.p.m., 440 volt, G.E.
100-hp., 720 r.p.m., 440 volt, G.E.
100-hp., 1120 r.p.m., 220 volt, West'se.
200-hp., 600 r.p.m., 2200 volt, G.E.
250-hp., 580 r.p.m., 2200 volt, West'se.
The last motor is a Type "C" and will carry a 500-hp. continuous load. V. M. Nussbaum, Ft. Wayne, Ind.

A.C. Generators For Sale

52½ kw., 900 r.p.m., three phase, Electric Machinery Co., 175 kw., 600 r.p.m., two-phase Allis-Chalmers. Both 2300 volt, 60 cycle, modern revolving field type. V. N. Nussbaum, Ft. Wayne, Ind.

MISCELLANEOUS

Electricians

Send $1.50 for 16 blue prints of motor windings. 10 A.C. single, two and three-phase and 6 D.C. or set of 20 A.C., 6 D.C. and 6 rotary converter drawings for $2.25. Connecting and winding made easy. Superior Electric Co., Lock Box 1372, Pittsburgh, Pa.

Electric Light Plant For Sale

A modern, developed electric light plant equipped with crude oil burner, Diesel engine; which means extremely low overhead expense; in progressive Mattoon, Wis. 1000 population. Public Service Company.

POSITIONS VACANT

A LARGE manufacturer of incandescent electric lamps located near New York has an excellent opening for a young man with technical electrical training whose duties will be largely to follow the commercial application of the product. Most of the work will be handled by correspondence, but it will be necessary at times to go out into the field for information, in such cases dealing directly with the customer. Give complete details as to education, salary wanted, etc., in your reply. P-486, Elec. World, 935 Real Estate Trust Bldg., Philadelphia.

ASSISTANT sales manager wanted, one familiar with steam engines preferred. Give experience and salaray expected in first communication. P-519, Elec. World, Old Colony Bldg., Chicago.

CHIEF operating engineer wanted in 5000 k.w. station, turbine driven, near New York City. Duties include load dispatching over high tension transmission system to several substations. State fully experience. P-536, Elec. World.

WANTED

Technical Graduates

Mechanical or Electrical Engineering. Experience unnecessary.

D. P. S., Box No. 1627, Charleston, W. Va.

ELECTRICAL DRAFTSMAN

Wanted by a PUBLIC UTILITY CORPORATION. Must be experienced in Power House and Sub-Station work, cable runs, oil switch layouts and switchboards. Work most likely in connection with alterations and replacements of existing equipment. Location this city.

Applicants must state experience, age and salary, otherwise not considered.

WM. F. MONAGHAN
Box 37, Station D, N. Y. Post Office.

POSITIONS VACANT

DRAFTSMEN for electrical designs on generating and substation layouts. Reply, giving age, experience and salary expected. Employment Bureau, Commonwealth Edison Company, 72 W. Adams Street, Chicago, Ill.

DEVELOPMENT engineer. Young engineering graduate wanted for experimental development work on electrical apparatus. Distinctive opportunity for young man of energy, resourcefulness and supervisory capacity to grow with new engineering developments of a fundamental nature. Salary determined by qualifications. P-535, Elec. World.

ELECTRICAL repairman. First class man desired, who has had experience on 33,000 volt equipment, such as motor operated oil switches, transformers, electrolytic arresters, and the usual switchboard and other equipment of a 20,000 k.w. Central Station. Man must be a thorough workman and familiar with D.C. motors and starting apparatus and with both A.C. and D.C. generating equipment. Location, Middle West. State age, salary expected and give experience and references in first letter. P-531 Elec. World, Old Colony Bldg., Chicago.

Large Manufacturer of Electric Apparatus

desires a few young, live

Technical Graduates

for test floor work. Exceptional opportunities for advancement open to those making good

P-106 Electrical World,
935 Real Estate Trust Building,
Philadelphia, Pa.

POSITIONS VACANT

ELECTRICAL meter testers; several experienced testers on A. C. Watthour meters, for house to house work in Manhattan; apply in person, 514 W. 147th St.

ELECTRICAL man wanted capable of designing and developing split phase motors up to one-quarter horse power. P-514, Elec. World.

ENGINEERS, estimators, draughtsman and inspectors wanted on laying out and inspecting underground and overhead distribution lines, call or write. Distribution Engineer, New York & Queens Electric Light & Power Co., Bridge Plaza, Long Island City.

ESTIMATOR. One of country's largest electrical contractors requires services of a competent electrical estimator. Must thoroughly understand how to take off quantities from plans. Opportunity for right man. Give full details as to experience, age and salary expected. P-529, Elec. World.

EXECUTIVE engineer desires connection with industrial or public utility corporation in advisory or executive capacity. Broad engineering and executive training. Consulting work; industrial engineering, development and organization; financial investigations and adjustments; public utility appraisals; H. T. power transmission; railways, design, construction and operation. Age 40; degree E.E. PW-519, Elec. World, 935 Real Estate Trust Bldg., Philadelphia.

ALL round practical electrician wishes position in charge of maintenance and construction in factory, plant and power and lighting plants. Also mechanic on gasoline engines, steam and machinery. PW-517, Elec. World, Old Colony Bldg., Chicago.

CAPABLE electrical engineer, technical graduate, seven years' varied experience, including two years general electric test, desires responsible position with manufacturer, public utility or consulting engineer. Would also consider sales work. At present employed by largest manufacturer doing field work in Connecticut. Location immaterial. PW-525, Elec. World.

ELECTRICAL engineer, ten years' experience as sales executive, recently relieved from active duty as officer in U. S. N. R. F., desires to represent established firm under territory contract. Only A1 proposition considered. References. PW-527, Elec. World, 935 Real Estate Trust Bldg., Philadelphia.

EXPERIENCED tester of electrical meters in power house and sub-station work to large Eastern system sought. Must be thoroughly familiar with both graphic and integrating meters of the various standard makes. A good technical education essential. I nreply, state experience and minimum salary wanted and address the Pennsylvania Water & Power Co., Holtwood, Pa., c/o Testing Dept.

FIRST-CLASS electrician wanted to read and test meters, inspect wiring and answer minor trouble calls. Only experienced man need apply. Sumter Light & Ice Plant, Sumter, S. C.

FIVE young engineers wanted interested in power house and substation work to lay out electrical circuits. This is a particularly good opening for men who have not finished their technical course. Permanent positions with unusual opportunities for advancement. State age, experience, and salary expected. Address, P-511. Elec. World, Leader-News Bldg., Cleveland.

EXPERIENCED construction superintendent wanted to install steam piping, condenser, turbo-generator, switchboard, rotary converter and all equipment for 2500 k.w. power house in Cuba. State age, experience, technical training, married or single, salary expected; give references and when available. P-520, Elec. World, 935 Real Estate Trust Bldg., Philadelphia.

POSITIONS VACANT

EXPERIENCED electrical engineer wanted to take full charge of small plant. Must be able and willing to work himself. In answer, state wages expected and experience. P-474, Elc. World.

FOREMAN for electrical instrument testing department. Applicant should have had executive, practical and technical experience. This position is open only to a man who appreciates the value and necessity of maintaining and improving the quality of the products. In reply state age, past experience and compensation desired. Address P-523, Elec. World.

GRADUATE electrical engineer wanted; capable draughtsman familiar with best modern electrical construction practice. Location eastern city. Give education, experience, reference, age, nationality, when available and salary expected. P-521, Elec. World, 935 Real Estate Trust Bldg., Philadelphia.

HIGH grade electrical man wanted to take charge of large electrical repair shop in New York City. Must understand the repair business thoroughly. Address P-526, Elec. World.

JUNIOR research engineer. A long established industrial organization in a rapidly expanding field has an attractive opportunity for a young man of first-class ability and thorough training in electrical engineering or technical physics. Post-graduate training desirable but not insisted upon. Prospects limited only by ability. Salary proportionate to education and record. P-533, Elec. World.

LARGE operating company desires to receive applications for positions from operating Diesel engineers or from competent men who have had machine shop or automobile experience who are ambitious to become Diesel operating engineers. This is a promising field for competent and ambitious men. P-518, Elec. World, Rialto Bldg., San Francisco.

LINEMEN, steady position with utility company within 50 miles of Chicago. P-506, Elec. World, Old Colony Bldg., Chicago.

MATERIALS man. Large firm of constructing engineers require services of man familiar with electric or steam materials, appliances and sources of supply to assist in pricing estimates. A good position. State full details and salary expected in first letter. P-528, Elec. World.

MECHANICAL draftsman wanted by well-established company, manufacturing a complete line of D.C. and A.C. generators and motors. Good opportunity for expeenced man who is capable of working into position of assistant chief draftsman. State age, experience and salary expected. P-512, Elec. World, Leaders-News Bldg., Cleveland.

SEVERAL mechanical draftsmen to assist in design of large modern power plant. Location near Chicago. Good salary. State experience and qualifications in first letter. P-518, Elec. World, Old Colony Bldg., Chicago.

SUPERINTENDENT wanted to take charge of new department. Must be familiar with fractional horsepower motor production in all its details. P-521, Elec. World.

TECHNICAL graduate wanted as draftsman for power transmission company in power house, sub-station and transmission line work. State age, nationality, education, experience and salary expected. Address H. L. S., 1638 Marine Trust Bldg., Buffalo, N. Y.

YOUNG engineer of sound technical training desired in connection with the developing of new high frequency electrical apparatus. Good grasp of physical and mathematical fundamentals important. Signal Corps experience useful. Permanency assured. Give details of training, experience and salary desired. P-534, Elec. World.

EMPLOYMENT AGENCIES

Employment Service

A SIGNIFICANT number of employers, and executives in positions of authority, who have had past opportunities to observe from the viewpoint of the employer the methods used by the undersigned; have afterwards become clients of this service themselves. Correspondence is invited from men qualified for positions between $2500 and $25,000 only. Negotiations ducted along lines of highest professional ethics. Established 1910. R. W. Bixby, strictly confidential and individual; con-310 Lockwood Building, Buffalo, New York.

POSITIONS WANTED

ACCOUNTING executive — expert auditor accountant—available immediately. PW-508, Elec. World.

ARMATURE winder, experienced motor repairs, desires steady position, state conditions, salary, etc. M. Schwartz, 551 Claremont Parkway, Bronx, N. Y.

CONSTRUCTION or appraisal work, technical graduate in electrical engineering; five years' railway, power and telephone experience. Lieutenant in U. S. Army. C. L. P., 124 West 113 Place, Chicago.

ELECTRICAL engineer; technical, literary and commercial graduate. Three years electrical, three years commercial experience. Desires position with manufacturing or central station company. Minimum salary $150 per month. PW-517, Elec. World, Old Colony Bldg., Chicago.

ELECTRICAL engineer, technical graduate, member A. I. E. E.; ten years' experience in design of electrical control apparatus, eight years on engineering staff of largest manufacturer of control equipment, two years assistant to consulting engineer. Have handled estimates, specifications and engineering correspondence. Location optional; age, 38; married; salary, $3600. PW-504, Elec. World, Old Colony, Bldg., Chicago.

INVENTION development. Graduate engineer can fill responsible position in connection with new apparatus; fifteen years in experimental work, design and manufacture; five years, sales and management. Experienced in cable, fog signal, automobile, telephone and telegraph. PW-491, Elec. World.

LET me put some life in that run-down plant of yours. Electrical Engineer, PW-522, Elec. World, Leader-News Bldg., Cleveland.

Engineer having been in turn Factory Manager, Sales Manager and President of prominent electrical manufacturing company, after three years as Officer in Government service, is without employment. 36 years of age, married, industrious and loyal. No reasonable offer ignored.

PW513—Electrical World
36th St. and 10th Ave., New York City

EXECUTIVE POSITION

by a practical and technical man, fifteen years' lighting, power and street railway experience. Excellent references and at present employed.

PW516—Electrical World
Tenth Ave. at 36th Street, New York City

POSITIONS WANTED

MANAGER of electric light and water works plant would like to get in touch with a municipal or private corporation in southern town of from 4000 to 12,000 population, that is contemplating the employment of an efficient manager. A certain salary with a per cent of the profits would be interesting. Eleven years' experience in the operation, constructing and management of electric light, power and water works plants. Age 34. PW-532, Elec. World, Old Colony Bldg., Chicago.

METER supt. ten years in meter and distribution depts. and public utility work. PW-520, Elec. World, Old Colony Bldg., Chicago.

OPEN for engagement as general manager of electric light, power and street railway properties. Over twenty years experience in these lines. Can furnish A-1 references. Would consider going to South America and Foreign Countries. PW-516, Elec. World, 935 Real Estate Trust Bldg., Philadelphia.

RESEARCH, commercial testing or inspection work desired by technical graduate, 31; experienced; Central Station management also considered. PW-530, Elec. World, Old Colony Bldg., Chicago.

SALES manager with wide experience and thorough knowledge of the electrical trade, would like to represent manufacturer in New York or vicinity. Can cover jobbers, contractors, engineers, or industrial plants on any commodity. Age 25, married, Christian, excellent references. PW-522, Elec. World.

SLOVAK, industrious and honest, age 25 years; single; I. C. S. graduate; knowledge of elementary electricity, magnetism, mechanics and mathematics; 2 years electrical construction; now employed; desires a position in Chicago, offering development. Address, PW-523, Elec. World, Old Colony Bldg., Chicago.

THOROUGHLY experienced practical electrician with some technial training desires to locate with power company as assistant to an electrical engineer. Now in charge of large industrial power installation. Age, 22; married. W. J. Rider, Binghamton, N. Y.

YOUNG man, 26 years old, desires position as manager of meter department with Eastern central station company; four years' experience in testing, repairing and installing single and polyphase watthour meters. PW-489, Elec. World.

YOUNG man (20), technical school graduate, 2 years' electrical experience, including radio testing, desires position with future. PW-524, Elec. World.

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FOR MOLDED INSULATION DEPARTMENT WHERE ABILITY TO UNDERSTAND MECHANICAL APPLICATIONS AND DESIGNS IS DESIRABLE, SO THAT WITH SOME TRAINING HE WILL BE ABLE TO MAKE SUGGESTIONS AND ALTERATIONS IN PROPOSED PARTS OR PIECES SUBMITTED.

The Cutler-Hammer Mfg. Co.
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For Sale or Lease

A combination ice and electric light plant in one of the healthiest and wealthiest sections of South Carolina. Steam and oil driven electric units. Plant and business in fine condition. Will sell at low price and long terms. An excellent opportunity to own a fine business with only a moderate outlay. Address, Light and Ice Plant, Elec. World.

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Manufacturers' Agent in Canada

Having an established connection among jobbers, contractor dealers and hardware trade. AS-509, Elec. World.

Wants Agencies

Can produce results. Good office and warehouse space. References and financially responsible. AS-510, Elec. World.

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WANTED

A manufacturer of Induction motors located in the Middle West is about to appoint distributors for the sale of its product. An exceptional opportunity is offered to good motor salesmen to make a profitable and permanent connection. Would particularly like to hear from good men for Chicago, Detroit and Philadelphia territories.

AS-515 Electrical World,
657 Leader News Bldg., Cleveland, Ohio.

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Patents, trademarks, copyrights—If you have an invention, write for our Free Illustrated Guide Book and evidence of conception blank. Send model or sketch and description for our free opinion of its patentable nature.

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845 9th Street, N. W., Washington, D. C.

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SALESMAN wanted with electrical knowledge and experience as direct factory representativ to travel Philadelphia territory, calling on users of and dealers in electrical apparatus. Good opportunity for a keen, up-to-the-minute man. Address AS-507, Elec. World, giving full particulars at first writing. Application confidential.

ELECTRICAL engineer, experienced salesman, wishes to become manufacturer's agent in N. Y. territory for electrical or mechanical engineering goods. Carl Kroft, 401 East 87th St., N. Y. City.

Electrical Sales Agency Opens New York Office

Electrical sales agency, with headquarters at 22 West 32nd Street, New York City, would like to secure the representation of several manufacturers who are desirous of selling their product to the jobbing trade of New York and neighboring territory. It would also like to entertain sole agency propositions.

WANTED

Second Hand Meters Wanted

To buy some good second-hand meters for 220 volt direct current; quote prices when writing. Overton Light Plant Co., Overton, Texas.

WANTED

Educational institution anxious to obtain first eight **VOLUMES ELECTRICAL WORLD** to complete file. Can our readers furnish any or all of these? Will pay reasonable premium to obtain volumes. Send statement as to price and condition to W-515, Elec. World.

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BLISS Electrical School, Washington, D. C., again open to civilians. Condensed course in electrical engineering. Complete in one year. For men of character, ambition, limited time. Principles and application of electricity, mathematics, steam and gas engines, mechanical drawing, shop work, construction, installation, testing. Fireproof dormitories, dining hall, laboratories. Twenty-seventh year opened Oct. 1. Catalog. 129 Takoma Ave., Washington, D. C.

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the equipment or machinery that you are not using. This may be occupying valuable space, collecting dust, rust and hard knocks in your shops and yards.

SELL IT BEFORE DEPRECIATION SCRAPS IT

THE SEARCHLIGHT SECTION IS HELPING OTHERS— **LET IT HELP YOU ALSO.**

The DURADUCT Twins are great little helpers out on the job

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To Protect the Gears of an Automatic Stoker a Gear Lubricant Must—

(1) Stick to the gear teeth.
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You Can Get This Kind of Lubrication for Your Gears,

Texaco Lubrication Engineers have made practical tests with every type of automatic stoker in use today. They determined the right lubricant for every gear on a stoker. In turn, the lubricants they recommended were re-tested by the engineers of the manufacturers. Some of the larger ones now recommend the oils we mention below as efficient, gear-saving lubricants.

For Gears Enclosed In Oil-tight Cases

Texaco Thuban Compound

It resists heat. It stays on the gear teeth, worm or spur. Prevents wear. Prevents noise. Makes the gears last longer. Texaco Thuban Compound works with equal efficiency on chain drives, inclosed or exposed.

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Texaco Crater Compound

It sticks to the gears. Protects and lubricates in spite of coal dust. Heat does not thin it out. Cold temperature does not make it harden. It remains a lubricant always—cushioning the gear teeth, saving the gears, making them last longer.

If you are having any kind of trouble with any part of an automatic stoker, tell us about it. Ten to one, our Engineers have met it before and found the remedy. Any lubricant recommended by Texaco Lubrication Engineers is right the first time. The quality of all Texaco Products is guaranteed by The Texas Company.

Write for pamphlet on "Lubricating the Automatic Stoker."

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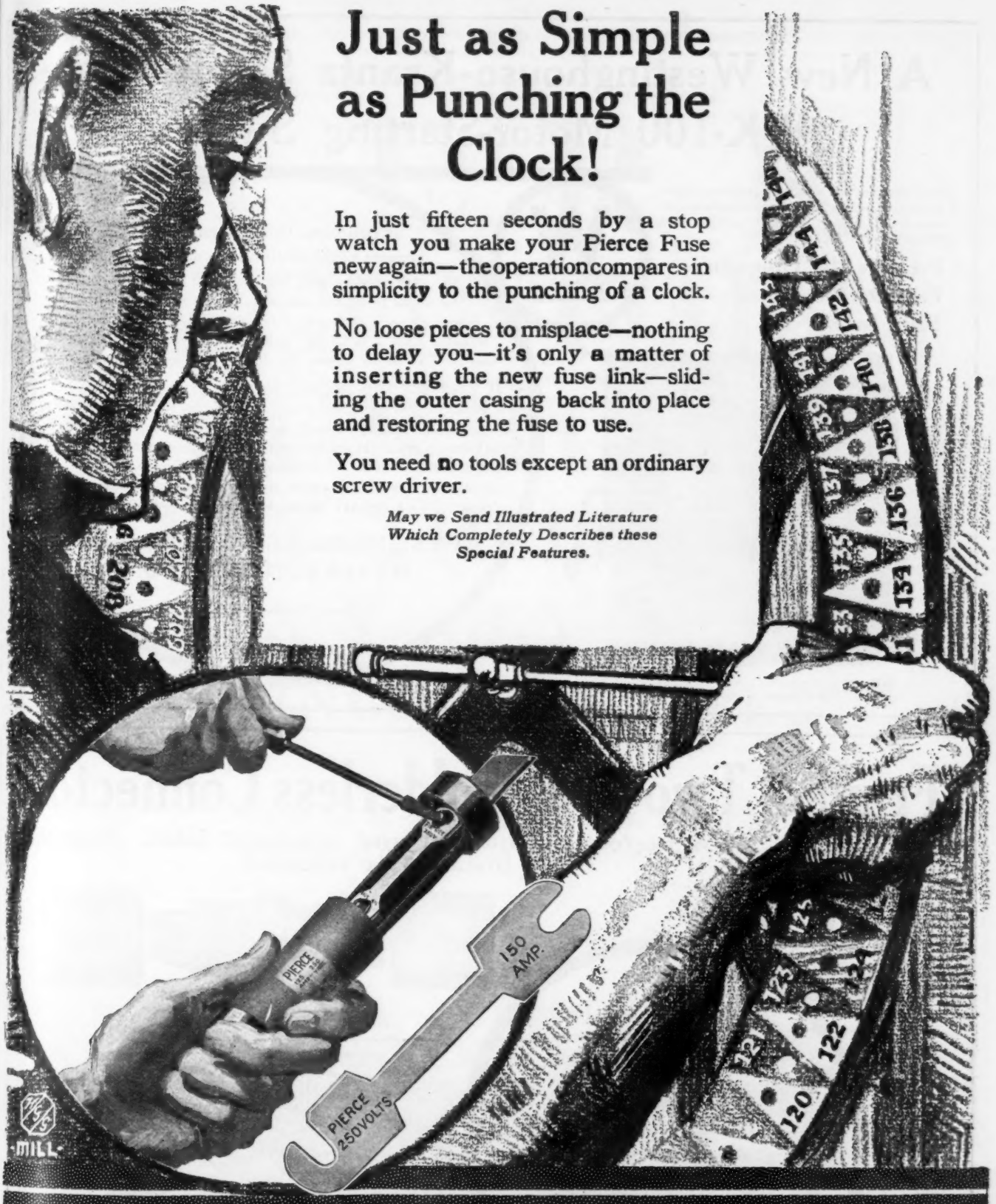
Just as Simple as Punching the Clock!

In just fifteen seconds by a stop watch you make your Pierce Fuse new again—the operation compares in simplicity to the punching of a clock.

No loose pieces to misplace—nothing to delay you—it's only a matter of inserting the new fuse link—sliding the outer casing back into place and restoring the fuse to use.

You need no tools except an ordinary screw driver.

May we Send Illustrated Literature Which Completely Describes these Special Features.



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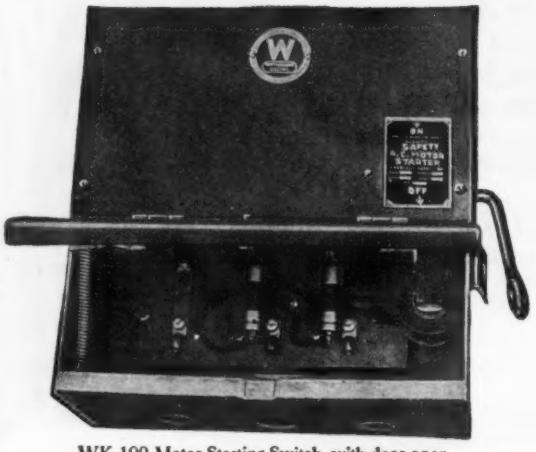
PIERCE
RENEWABLE FUSES

A New Westinghouse-Krantz Safety Type WK-100 Motor-Starting Switch

For connecting A. C. single or polyphase motors directly to the line without the use of auto-transformers or resistance. Capacities 1 to 10 hp., 350, 440, 550 and 600 volts.

Protects the Operator
Protects the Motor
100% Safe



WK-100 Motor-Starting Switch, with door open, showing ease of inspection.

W WESTINGHOUSE ELECTRIC

It protects the Operator, because all the mechanism, excepting the operating handle, is enclosed in a steel box. The current relays and voltage coils are readily accessible through a door in the cover. This door can be opened only when the switch is in the "off" position, and all reachable parts are dead. The switch cannot be closed while the door is open.

It protects the Motor, by means of a magnetic release, which opens the switch automatically on a failure of voltage. Overload protection is provided by means of current relays, connected in series with the release magnet. Harmless momentary overloads do not affect the relays, but as soon as the overload becomes dangerous, the relay contacts open the magnet circuit, and the switch automatically flies open. The relays then automatically reset themselves.

WESTINGHOUSE ELECTRIC & MANUFACTURING CO.

East Pittsburgh, Pa.

Frankel Two-Way Solderless Connector

A perfect mechanical and electrical joint. Rapidly installed or released.

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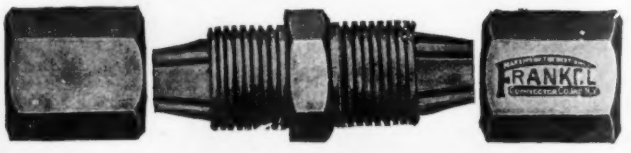

To make a splice, bare both ends of cable, or wire, and insert to meet in center of connector, then screw up the compression nuts, which force the jaws to grip the cable, or wire, firmly, making a perfect mechanical and electrical joint. Supplied for all sizes of cable or wire.

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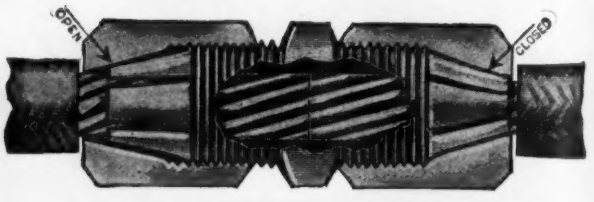
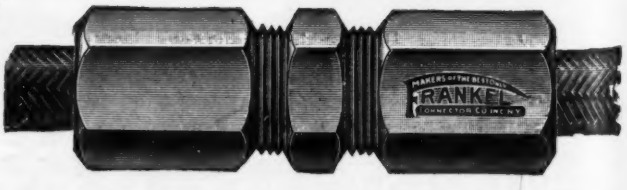


MAKERS OF THE BEST ONLY FRANKEL CONNECTOR CO. INC. N.Y.



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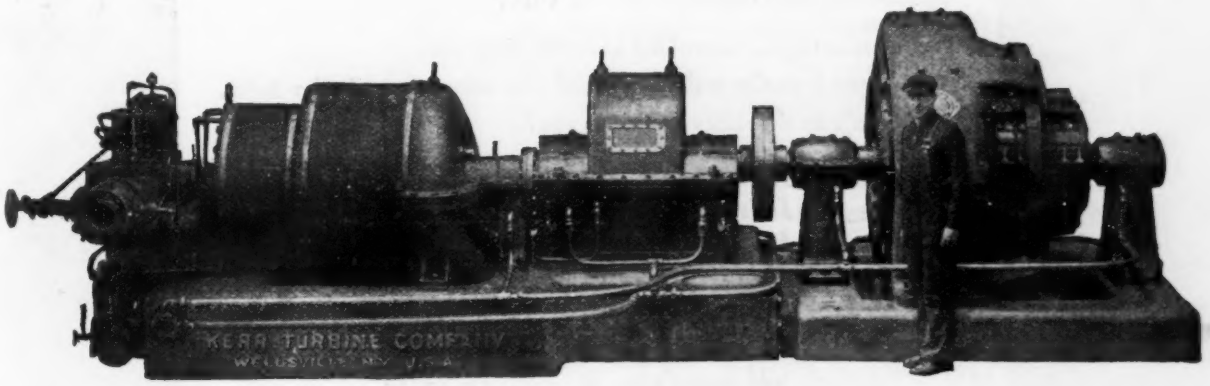
KERR ECONOMY TURBINES PAY THEIR OWN WAY BY THE SAVINGS THEY EFFECT

Write us of your requirements or let us send one of our men to talk it over with you.



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"Home of Kerr Turbines"

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holds the wires firm and close to the wall

That's why we gave it the name
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Instead of using three different units (brackets, insulators and tie wires) to hold your service wires, you use only one—the **Wireholder.** It is bracket, insulator and tie wire all in one.

It comes to you assembled as a complete unit.
You put it on the wall and thread the wires through the holes.
Doesn't its simplicity appeal to you?

It costs less.
It is stronger.
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See your Jobber. He carries the **Wireholder** in six styles.

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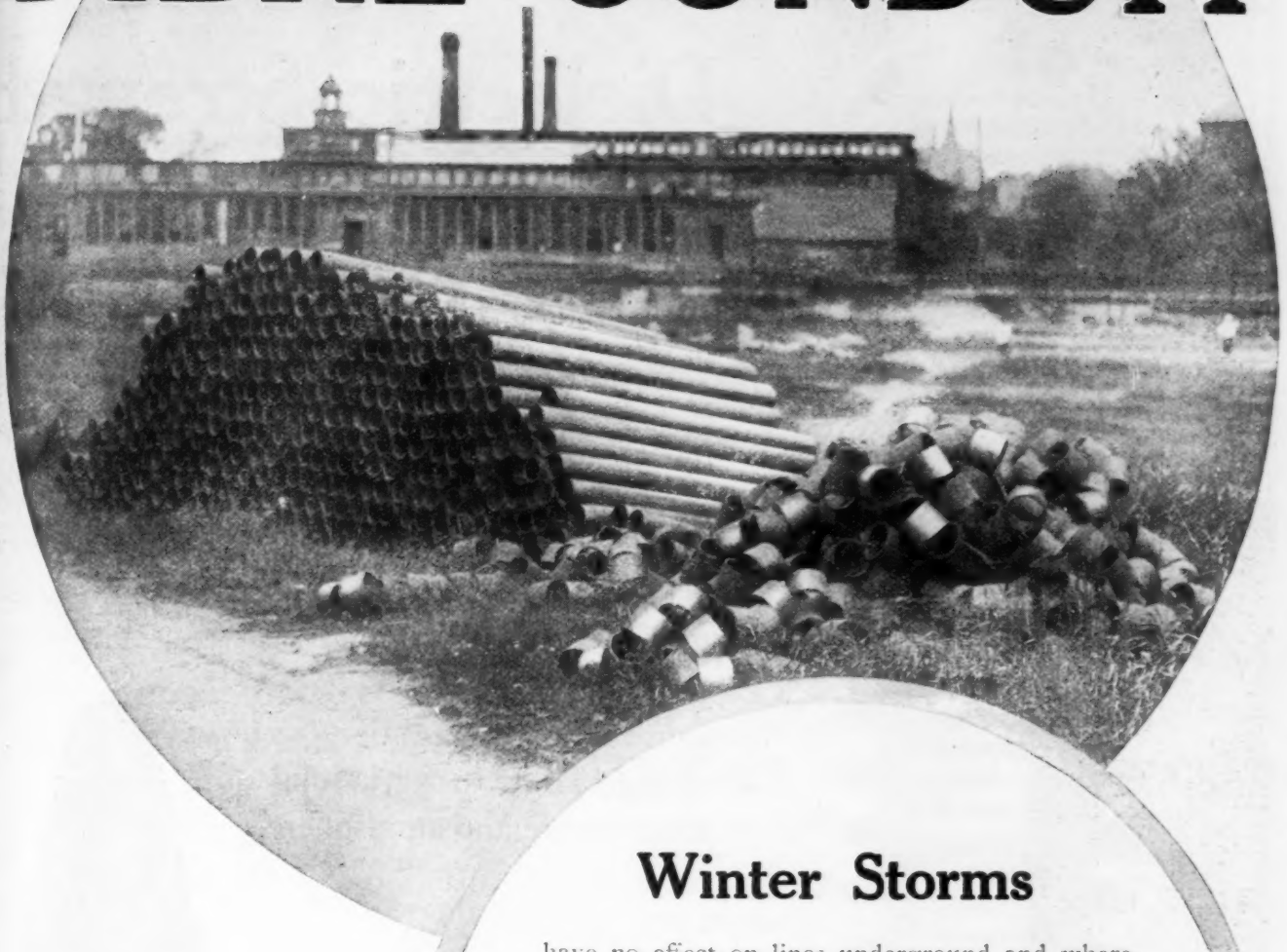

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have no effect on lines underground and where continuity of service is a vital factor in production ORANGEBURG FIBRE CONDUIT as a housing for your cables will banish your worries from that cource, besides freeing your trouble shooters from dangerous work on overhead lines during stormy weather.

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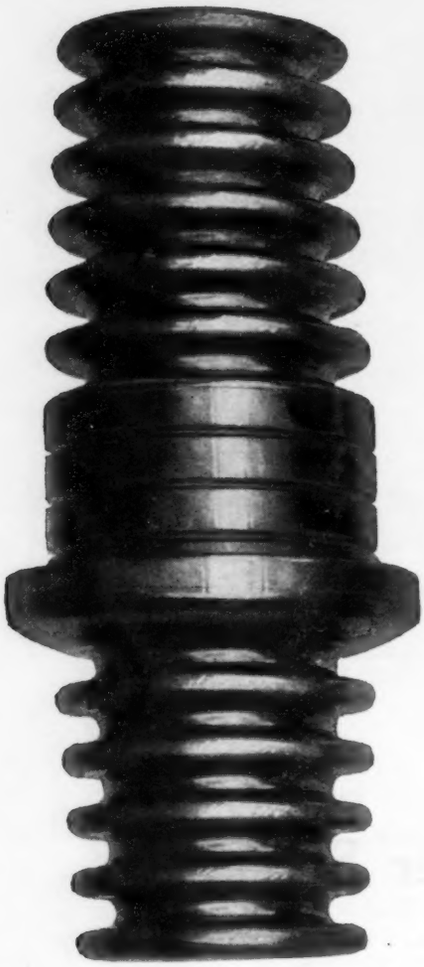

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is 500 volts per mil. in a thickness of 250 mils.

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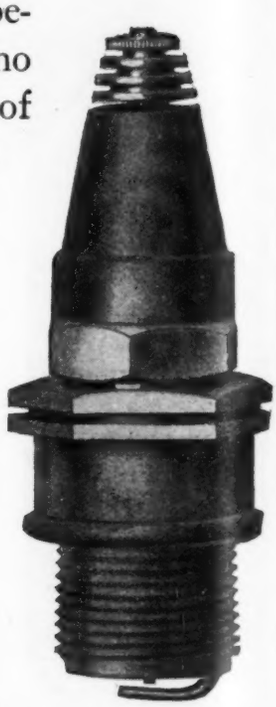

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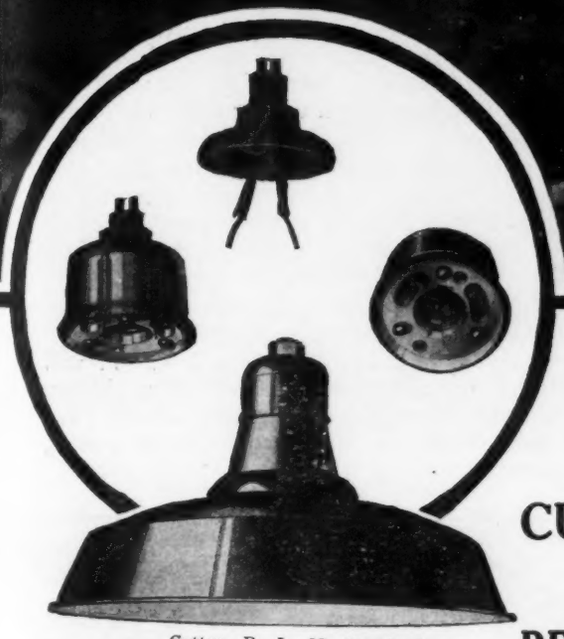

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LIGHTING IMPROVEMENT MADE EASY WITH

CUTTER R L M STANDARD DOME TYPE

REFLECTORS *and* HOLDER SOCKETS

Are you satisfied with the lighting of your plant? If you were convinced that improved lighting would increase your production from 10% to 35% you could not afford to go without the best lighting.

Cutter R L M Standard Dome Reflectors with Holder-Sockets are today being installed in industrial plants the country over.

Cutter Holder Sockets are the easy-to-wire kind. One man can install a complete fixture in 2 minutes. They embody all the features of **flexibility, safety** and **economy.**

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South Bend, Ind.

Even Where Fuel Costs Nothing It Pays to Use "85% Magnesia"

COAL-SAVING is not the only reason for your using "85% Magnesia" pipe and boiler coverings. Higher STEAM-EFFICIENCY you will find to be an equal reason.

Here, for example, is a great sawmill plant—the Kaul Lumber Company of Kaulton, Ala. It is a model of modern industrial efficiency. Its 2,000 H.P. boiler not only provides steam for all mill operations, but also ample steam for the drying-kilns and other buildings.

Its fuel costs nothing, for it burns its own waste lumber-cuttings. So plentiful is that waste that a big incinerator runs day and night to burn up its slabs, cuttings and sawdust, which become a daily nuisance.

Yet, although this fuel costs nothing, all the steampipes and boilers *are protected with "85% Magnesia."*

The reason is, of course, that "85% Magnesia" insures higher EFFICIENCY—that in place of a wet, "soggy" vapor, the engines, kilns, etc., always have ample supply of hot *dry steam.*

While Coal-Saving, to an amazing degree, is *one* great reason for protecting with "85% Magnesia"—no matter whether your fuel cost is high or low, you will find that your operating conditions are always better, your steam supply always adequate, if you cover your pipes, boilers, flanges or fittings with this surpassing heat-insulation.

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He Likes Its Cleverness

EVERY man who sees the Franklin Disconnecting Switch the first time, plays with it. He likes the lock—its cleverness, its snap and strength. He pulls the ring and throws the switch time after time.

The Franklin Disconnecting Switch is an improvement on all other switches ever made. It is a strong, heavy, handsome switch, mounted on standard Franklin insulators. It is equipped with a pulling ring that opens wide two rugged brass jaws that bridge across the blade to lock it shut. The continuation of the pull opens the switch. The jaws are beveled and admit the blade when it is closed again, snapping back sharply in a positive lock. Electrical expulsion forces only tend to hold this lock more firmly in its place.

This Franklin Disconnecting Switch is made in sizes from 300 to 2,000 amperes to suit all conditions of service. It brings you both added convenience and security. Order the Franklin next time. Write now for full details.

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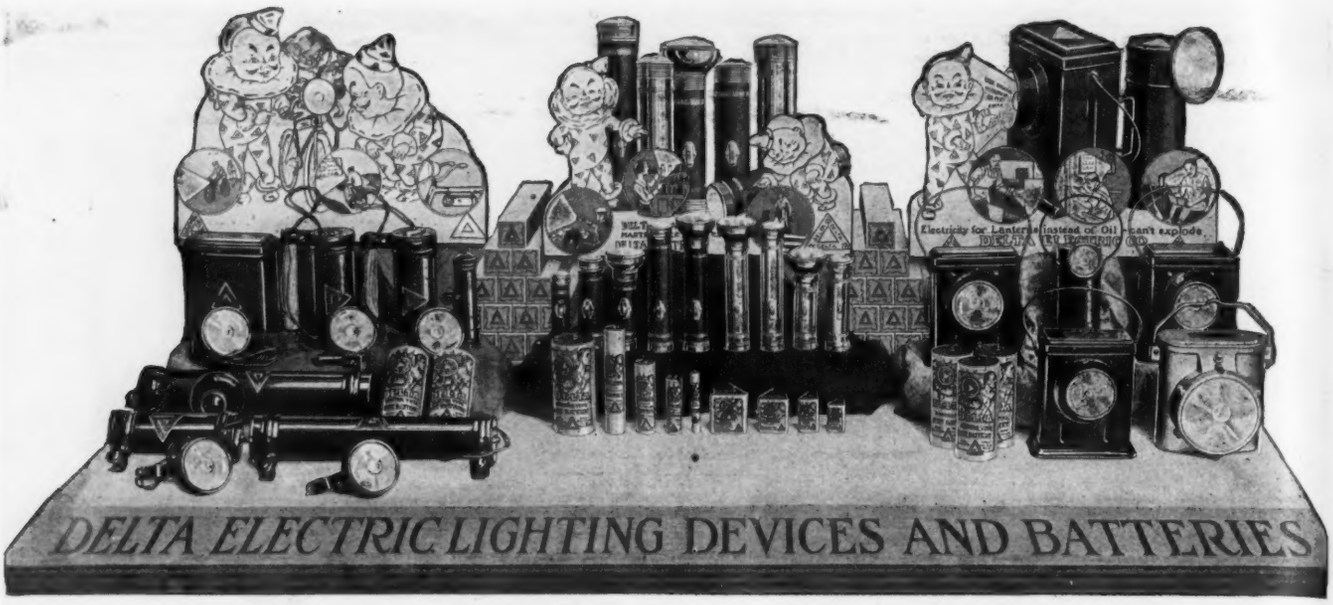

Here is the Big Family of DELTA Electric Specialties

This big, fast-selling line of flashlights, batteries, hand lamps and lanterns is one of the most attractive propositions yet offered to the dealer. It is the most profitable and fastest-selling line of nationally advertised electrical specialties on the market.

12 models of Flashlights — 5 Models of Bicyles and Vehicle Lamps — 9 sizes of Batteries — 4 models of Hand Lanterns and Lamps.

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The Delta line means much to you, Mr. Dealer. You can sell this extensively advertised, and distinctive line of electrical specialties at prices that will meet competition, get new business and bring to your store repeat orders and new customers.

Window Cut-outs for Display Furnished Free

There is more profit, more quality and style in this fast-selling Delta line. Properly displayed, you will be astonished at the rapid sales and quick turn-overs.

Write for our Complete Proposition NOW

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General Offices and Factory: MARION, IND.

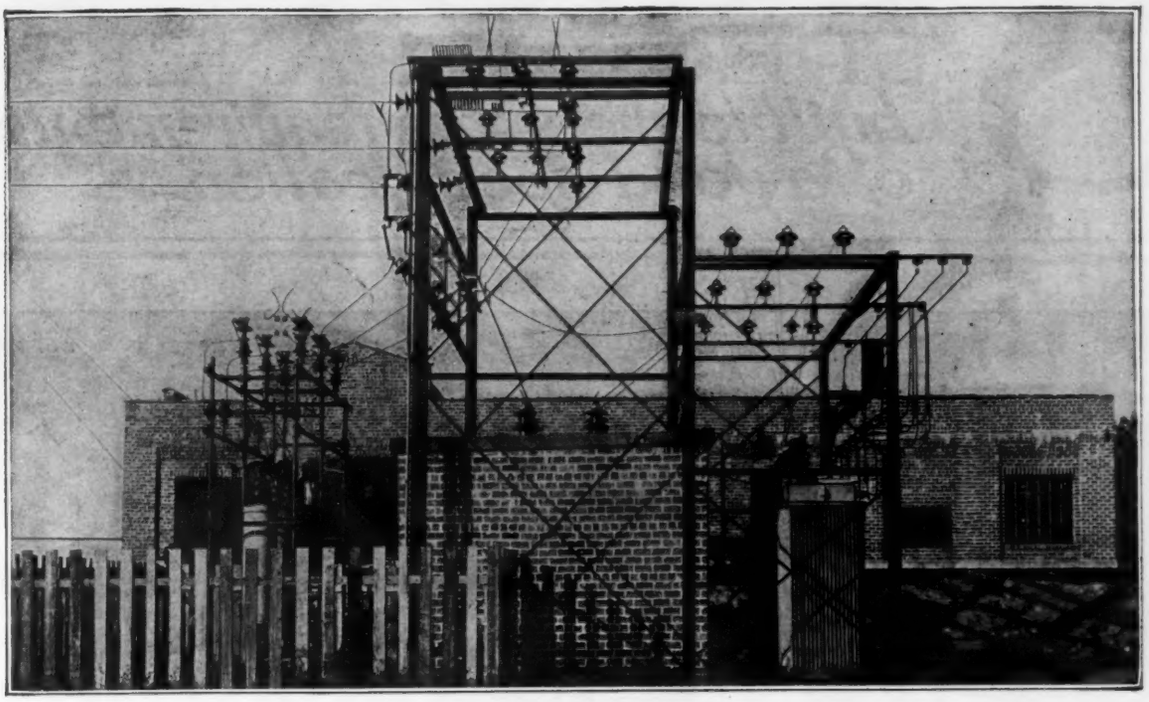
New York City **San Francisco** **Winnipeg**

World's standard batteries and electric lamps for hand use, bicycles, buggies, etc.

DELTA

HIGH TENSION EQUIPMENT

Unit Type Means Money to You



33,000 Volt Outdoor Sub-Station, Equipped with "Unit Type" Air-Break Switches, Choke Coils, Disconnecting Switches, Fuses, Bus Bar and Wiring Supports.

THE problem of obtaining financial backing is a serious one to the Central Station today. It needs no argument to convince you that the Station whose equipment and properties present a good engineering appearance, will attract capital most readily.

FURTHERMORE, the Station which impresses you with its "smartness" is bound to get a high valuation from the Public Service Commission, when it comes to the question of rates. And such a Station will also cause favorable comment from your customers.

THE engineers back of Delta-Star "Unit Type" Equipment are men who have had actual experience in Central Station operation. They are men who appreciate the problems confronting the Central Station today. They have given expression to their knowledge in the design and construction of Delta-Star "Unit Type" Equipment.

THEIRS is a *willing service* which is at your disposal. Get in touch with the "Unit Type" Idea. *It means money to you.*

Write for our latest bulletins today

Delta-Star Electric Company

2433-53 Fulton St., Chicago, Ill.

New York, N. Y., 100 Broadway
Boston, Mass., 76 Pearl St.
Rochester, N. Y., E. & B. Building
Syracuse, N. Y., City Bank Bldg.

DISTRICT OFFICES
Salt Lake, Utah, Walker Bank Bldg.
Toronto, Ont., 67 Yonge St.

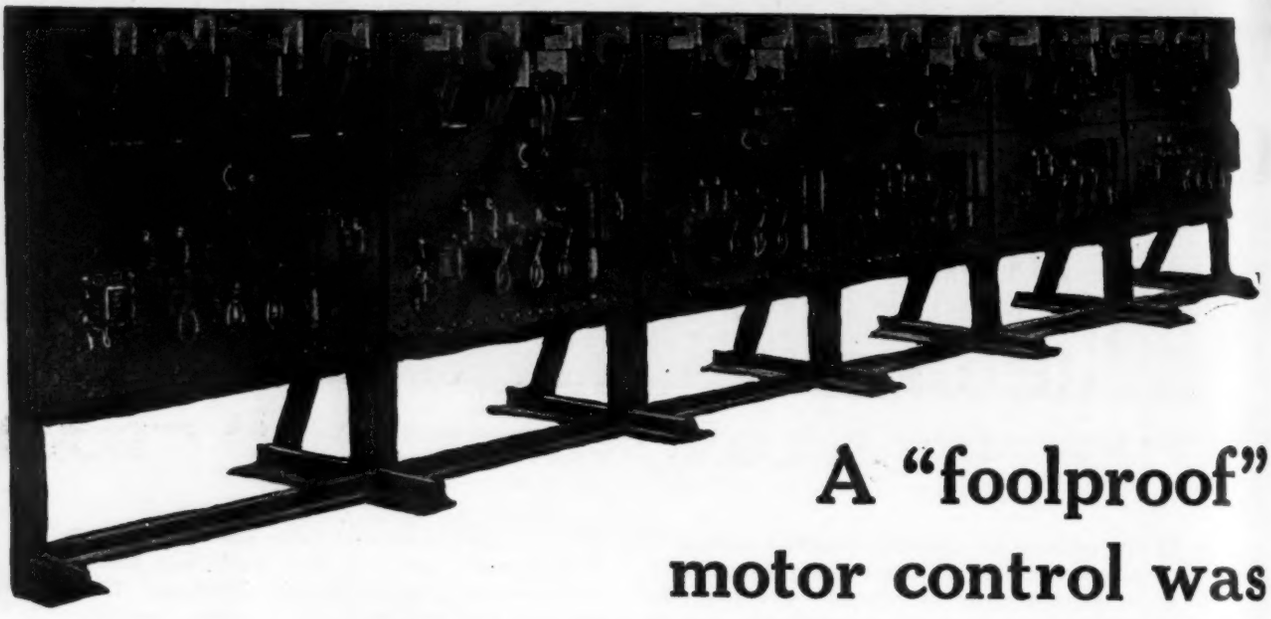
Seattle, Wash., Hoge Building
Philadelphia, Pa., 1231 Arch St.
Denver, Colo., 1633 Tremont St.
Pittsburgh, Pa., Union Arcade

DELTA-STAR HIGH TENSION EQUIPMENT

UNIT-TYPE INTERCHANGEABLE PARTS

SUNDH'S SPECIAL PANELS

built to meet the requirements of a good specification



A "foolproof" motor control was wanted for unloading equipment

The case was that of a ship loading and unloading device installed on an important pier.

It was necessary that this apparatus should be handled by rough and careless "dock wallopers." Consequently a motor control equipment was required that would be practically foolproof—an equipment, in fact, that would enable the owners to forget the human element altogether.

The illustration shows a few of the 34 special Full Magnet Control Reversible with Dynamic Brake and Overload equipments supplied by us to meet the above requirements

Ask SUNDH service to solve YOUR motor control problem.

—so they put it up to SUNDH

Sundh Electric Co.

Ave. C & Parkhurst St., Newark, N. J.
New York Office: 51 E. 42nd St.

First National Bank, Pittsburgh, Pa.
H. J. Kaufman, Peoples Gas Bldg., Chicago, Ill.

7

Send Us Your Specifications

Bridgeport Brass Tubes Stocked for Inspection.

Condenser Tubes and Ferrules

to be uniformly efficient must be made from Electric Furnace Brass

BRIDGEPORT ELECTRIC FURNACE BRASS

assures uniformity and the close following of specifications impossible by the old process.

The Electric Furnace—the greatest advance in brass making in 140 years—is responsible for similar improvement in sheets, rods and stampings for electrical manufacturers.

Because of the fact that better brass is produced by the electric method, **the entire output of this company is—Electric Furnace Brass. The crucible process has been entirely superseded.**

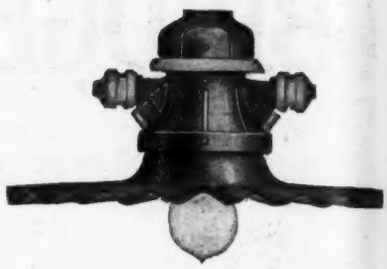
Bridgeport Brass Company

Bridgeport Connecticut

Street Lighting Fixtures

PEMCO

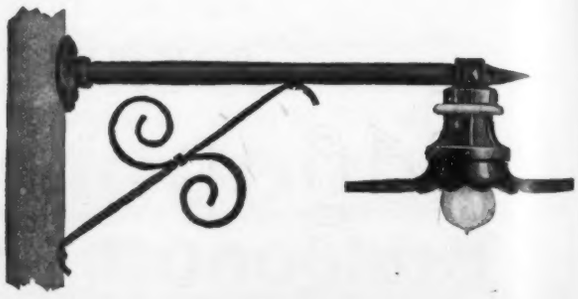
Japanned or Galvanized Finish



Philadelphia Electrical and Manufacturing Company

1228-36 N. 31ST ST., PHILADELPHIA, PA.

Send for Bulletin No. 23



HOME OF DOEHLER PRODUCTS

DOEHLER DIE-CASTING CO.

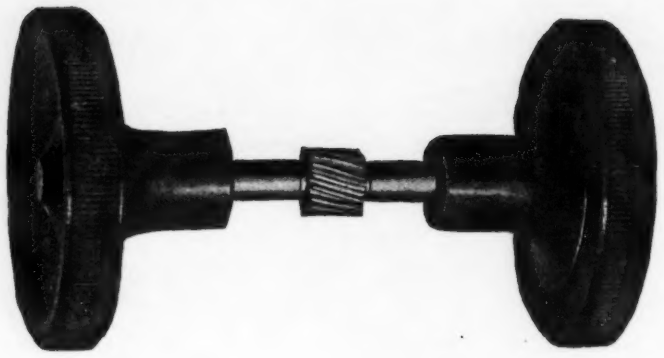
MAIN OFFICE AND EASTERN PLANT
BROOKLYN, N.Y.

WESTERN PLANT
TOLEDO, OHIO.

SALES OFFICES IN ALL PRINCIPAL CITIES

BAKELITE

REG. U. S. PAT. OFF.



These elevating screw handles were moulded of Bakelite for two reasons—serviceability and manufacturing economy.

Bakelite is serviceable because it will not crack or split after being moulded, is unaffected by heat, oil, water and acids, will not deteriorate from age or wear and has great mechanical and dielectric strength.

Bakelite is economical from a manufacturing point of view because it takes such a clean impression from the mould no handwork is required to finish even an elaborate edge, the piece acquires a smooth lustrous finish from the mould—which obviates buffing, and metal inserts can be incorporated in the moulding process, thus saving subsequent assembling operations.

Are not you too looking for serviceability and manufacturing economy in moulded parts? Use Bakelite.

The GENERAL BAKELITE COMPANY, 2 Rector Street, New York, welcomes inquiries from manufacturers and maintains a research laboratory for the working out of new applications.

20-50B

Service—then sales

HOW to defeat friction—this is the story carried to industry the country over by S K F representatives.

These men are, first of all, Bearing Engineers—salesmen only as they serve.

It is not too much to say that this man-to-man contact, backed by the fund of knowledge constantly available in the S K F Research Laboratories, will be an invaluable aid to the manufacturer in the correction of his technical difficulties.

And only on this basis is S K F Industries willing to undertake the examination of a bearing problem—not looking merely to the sale of a specific product, but on a far broader policy of rendering an honest impartial service.

American Manufacturers are invited to avail themselves of this service at any time.

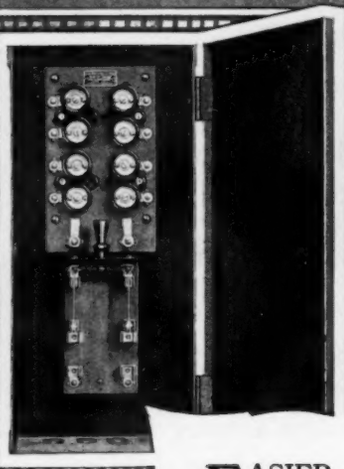
S K F INDUSTRIES, INCORPORATED
Sales, Service and Research Division
165 Broadway, New York

558

SKF INDUSTRIES

Hess-Bright Ball Bearings
S K F Ball Bearings
Atlas Steel Balls
Gronkvist Chucks
Transmission Hangers

Modernize the Wiring Job—Use the

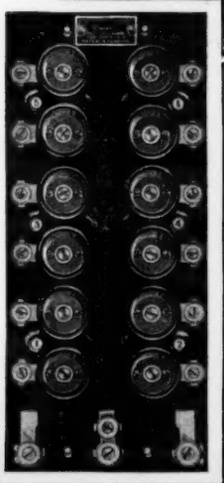


BENJAMIN-STARRETT PANEL CUT-OUT

EASIER and cheaper to install than any other form of Cut-Out mounted in a box. It is a complete unit in itself. The whole job is done with a Benjamin-Starrett Panel Cut-Out before a man working with porcelain blocks has had time to assemble his feed wires.

A complete installation consists of any standard cut-out box, a standard knife-switch of required capacity, and a Benjamin-Starrett Panel Cut-Out. All of these you can get quickly from your jobber's stock.

Quick deliveries and ease of installation save time and money. Superior appearance and increased safety features win instant approval of your customers.



We will be glad to send you further information

BENJAMIN ELECTRIC MFG. CO.

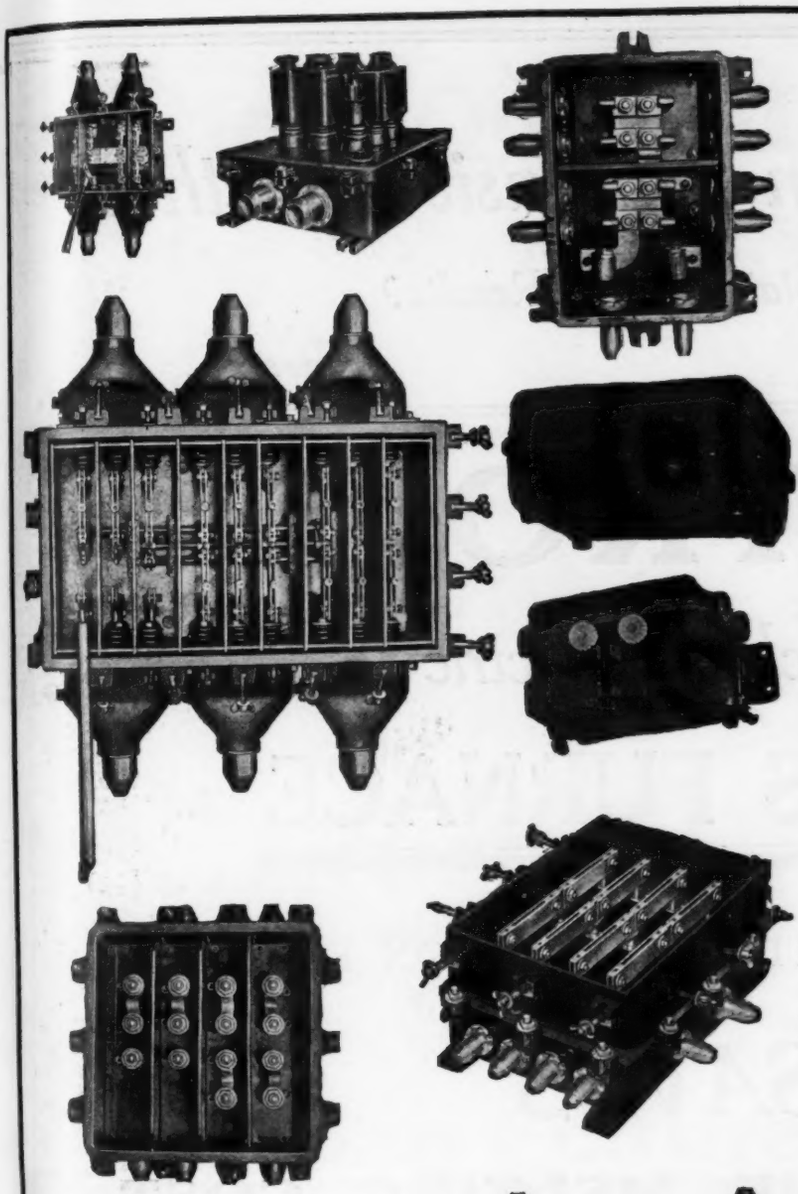
Sales and Distributing Offices:

806 West Washington Boulevard

247 West 17th Street NEW YORK — CHICAGO — 590 Howard Street SAN FRANCISCO

BENJAMIN

Makers of Things More Useful



So that the Industry will not form the false idea that we make only Potheads, we show here a few samples of our line of distribution and switching boxes.

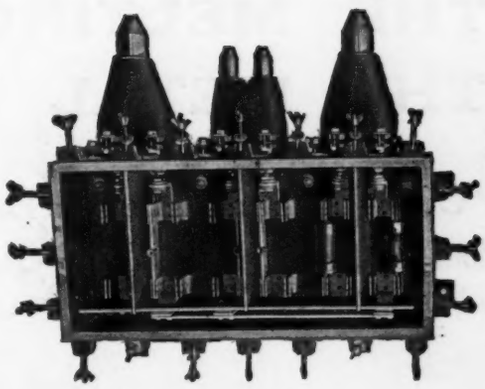
Our staff is composed of engineers experienced in solving distribution problems and we will gladly give you our cooperation in solving yours.

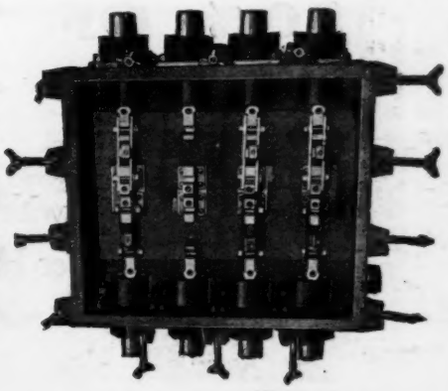
G & W Electric Specialty Co.

7440 So. Chicago Ave. Chicago, Ill.

Sales Representatives in the Larger Cities

Potheads
Single and Multiple conductor
Disconnecting and non-disconnecting
Distribution Boxes
Switching Boxes
Low Tension Tap Boxes
Splice Boxes
Street Pillars
Ground Pipe Caps and Points
Primary Cutouts Underground
Primary Cutouts Overhead
Series Cutouts Underground
Series Ctouts Overhead
Oil Cutouts
Conduit and Cable Hangers
Compounds.





G & W

DISTRIBUTION ENGINEERS

MANUFACTURERS OF DISTRIBUTION SPECIALTIES

Why use an Expensive Method

To Obtain Inferior Results?

THE

DETROIT

Rocking Electric

BRASS FURNACE

AS COMPARED WITH CUMBUSTION FURNACES

SAVES

50% OF THE MELTING COST

75% OF THE METAL LOSSES

As Compared with Other Electric Furnaces, the Detroit Produces
More Metal Per Hour — Of Higher Quality — At Lower Cost

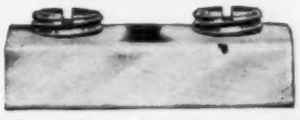
Detroit Electric Furnace Co.

642 BOOK BUILDING, DETROIT

LICENSED UNDER U. S. BUREAU OF MINES PATENTS

The 100% Electrician *says:*

"I can save the boss a lot of money by using the Sherman Fixture Connector—it is all brass — the screws ***can't come out***—it takes no time at all to make or break a connection with it. A screw driver does all the work—I need no acid, solder or blow-torch. With it I can make connections easier, quicker, cleaner, better—even in dark corners—and they take up less space when insulated."



Approved by the Underwriters

Sherman Fixture Connector

The Perfect Connector

It is made of solid, heavy brass with headed non-removable brass screws that ***can't come out.*** These features make the Sherman Fixture Connector an absolutely perfect connector.

A Time Saver

You can make a connection in about one-tenth of the time it now takes you with solder with the Sherman Fixture Connector, and you can make it easier, quicker, cleaner and better regardless of how poor the light is or how small the space is you have to work in.

Safe and Efficient

You need no acid, solder or blow-torch to apply Sherman Fixture Connectors. A screw driver is all that is necessary. This eliminates all chance of damaging walls, woodwork, furniture or fixtures and you get an absolutely strong connection.

Send for a Sample

Write today for a free sample of the Sherman Fixture Connector. Test it out and convince yourself of its superior features.

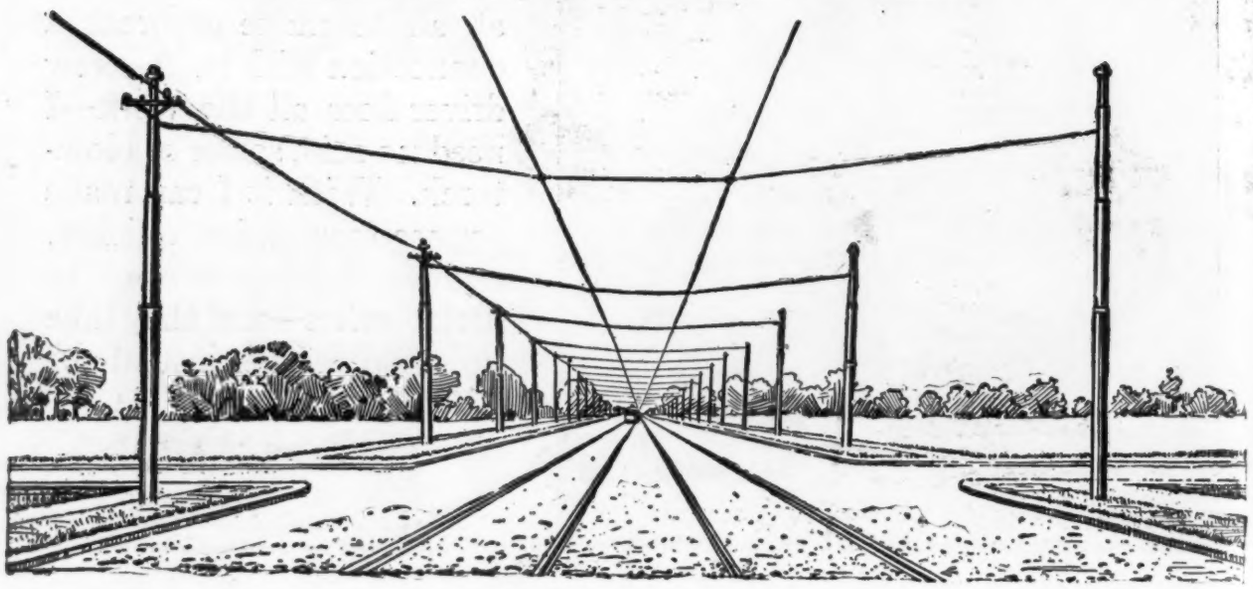
S

When the manufacturer of fixtures equips them with Sherman Fixture Connectors he improves his products and accommodates you. ***Insist.***

Sherman goods are quality goods—and the quality is never sacrificed. Every progressive jobber handles the Sherman Fixture Connectors.

H. B. Sherman Mfg. Company
Battle Creek, Michigan

ARMCO IRON
GALVANIZED
STRAND



Resists Rust because made of 99.84 per cent Pure Iron.

ARMCO IRON Strand has an extra heavy surface coating of spelter, but its remarkable resistance to corrosion is due chiefly to the purity of the iron from which it is made and not to surface treatment. It is permanently rust resisting through and through. The real economy of ARMCO IRON is particularly well demonstrated when the strand is exposed to unusual dampness, salt air, or the corroding fumes of factory districts.

When strength and safety are more important than conductivity or low first cost, ARMCO IRON Strand has fundamental advantages not obtainable in any other wire. The slightly higher initial cost is far more than compensated by fewer breakages and lower maintenance expense.

ARMCO IRON Strand is used as messenger strand, guy wire or strand, telephone wire or strand. trolley span wire, ground wire or strand, telegraph wire, and as power transmission conductors. Put up a trial installation and prove its worth. 68

PAGE STEEL & WIRE CO.

Established 1882 as Page Woven Wire Fence Co.

Makers of ARMCO IRON Welding Rods and Electrical Wire; "Copperweld" Copper Clad Steel Wire; Wire Mill Products, Plain and Galvanized; Wire of Special Analysis; Wire Fencing for all Purposes; Factory Gates; Ornamental Iron Fence; Machine Guards; Tool and Stock Room Partitions; Architectural Iron.

Plants: Monessen, Pa., and Adrian, Mich.

SALES OFFICES: 30 CHURCH STREET, NEW YORK

CHICAGO: 29 South LaSalle Street DETROIT: Book Building

CANADIAN DISTRIBUTORS: Taylor & Arnold, Ltd., Montreal, Toronto, Winnipeg

Careful Manufacturing

Whenever you order slate for electrical purposes from us you may rest assured that the greatest care will be exercised to meet specifications exactly.

The slate will be quarried from electrically-tested veins only and the order given really interested attention, from time of receipt to time of shipment.

If you have experienced delays or dissatisfaction elsewhere we would like to have you try our product, our workmanship and our service.

The Structural Slate Co.
Manufacturing Five Carloads Daily
Pen Argyl, Pennsylvania

Magnet Wire

ENAMEL

A new addition to our line. Furnished either plain or with silk or cotton covering.

ASBESTOS

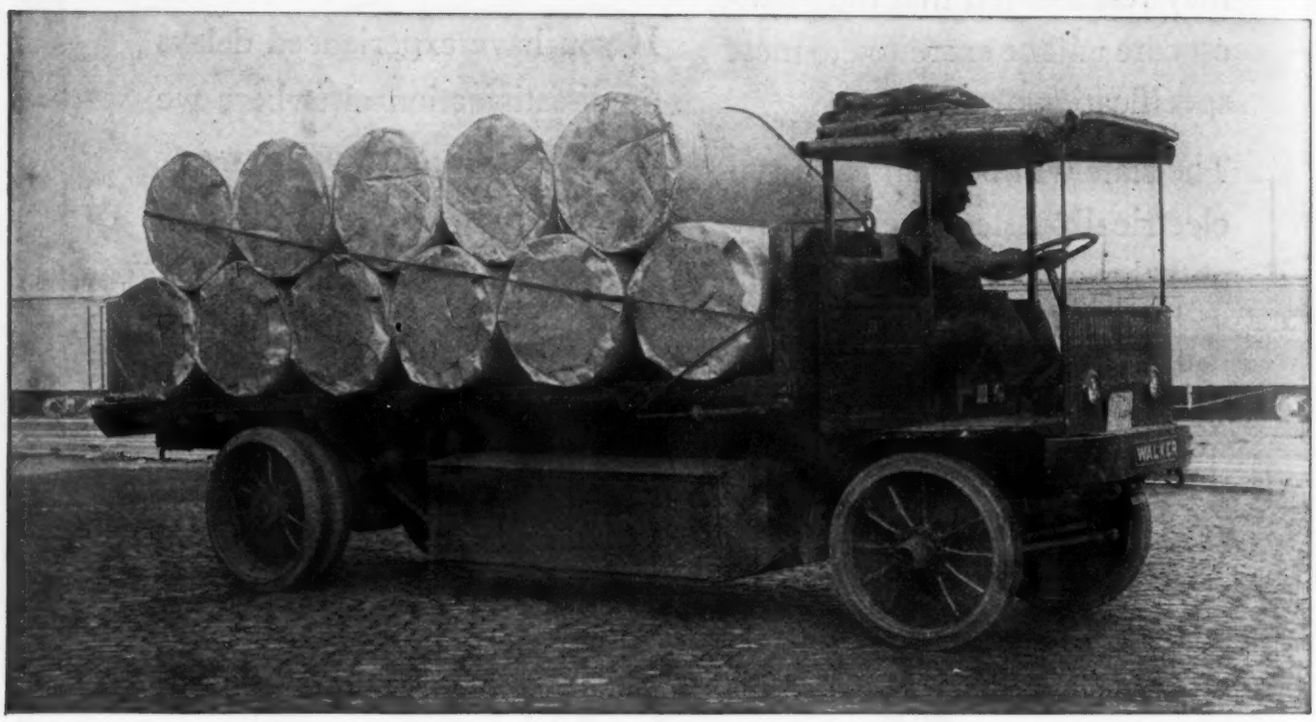
Our Salamander Pure Asbestos Insulated Magnet Wire is but one of our large line of asbestos insulated wires.

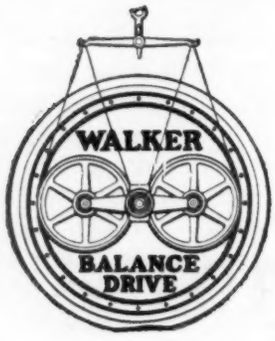
Special Salamander Asbestos Insulation for all classes of work.

Independent Lamp and Wire Company, Inc.

Offices: 1737 Broadway, New York *Works:* Weehawken, N. J.; York, Pa.

WALKER ELECTRIC TRUCKS





$ $ $

TRANSFER Companies sell transportation. The increasing numbers of Walker Electrics in this service proves that Walkers produce profits for transportation companies.

Walkers handle 80% of city trucking at 33⅓ to 50% less than gasoline equipment.

Ask any Walker User, Dealer or Branch

Walker Vehicle Company

America's Leading Manufacturer of Electric Trucks and Tractors

NEW YORK CHICAGO BOSTON

LOWEST-TRUCKING-COST

CIRCUIT BREAKER PHILOSOPHY

IF

a Circuit Breaker opens, it must be reclosed.

it requires a man to reclose it, it costs a lot of money.

you don't reclose it, you can't pay a man to reclose it.

you have an AUTOMATIC RECLOSING CIRCUIT BREAKER, you don't have to have a man to reclose it, but you could pay one if he were needed — BUT HE WON'T BE NEEDED.

THINK IT OVER

THE AUTOMATIC RECLOSING CIRCUIT BREAKER COMPANY

COLUMBUS, OHIO. U.S.A.

AMERICAN BRIDGE COMPANY

HUDSON TERMINAL-30 CHURCH STREET, NEW YORK

Manufacturers of Steel Structures of all classes particularly BRIDGES AND BUILDINGS

Sales Offices

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Boston, Mass.	*John Hancock Building*	*Salt Lake City, Utah*	*Walker Bank Building*
Baltimore, Md.	*Continental Trust Building*	*Duluth, Minn.*	*Wolvin Building*
PITTSBURGH, PA.	*Frick Building*	*Minneapolis, Minn.*	*7th Ave. & 2nd St., S. E.*
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Cincinnati, Ohio	*Union Trust Building*	*Pacific Coast Representative:*	
Atlanta, Ga.	*Candler Building*	*U. S. Steel Products Co., Pacific Coast Dept.*	
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CHICAGO, ILL.	*208 South La Salle Street*	*Seattle, Wash.*	*4th Ave. So., Cor. Conn. St.*

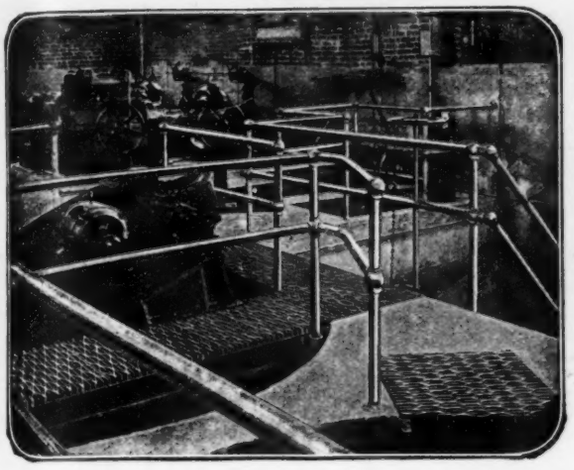
Export Representative: United States Steel Products Co., 30 Church St., N. Y.

To maintain a nation-wide telephone system affording communication between any two points in the country, complete co-ordination of all elements and factors under centralized control with one common policy is absolutely essential.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY AND ASSOCIATED COMPANIES

IRVING SUBWAY (PATENTED) TRADE MARK
THE FIREPROOF VENTILATING FLOORING

IRVING SUBWAY
TRADE MARK
(PATENTED) REG. U.S. PAT. OFF.
THE FIREPROOF VENTILATING FLOORING

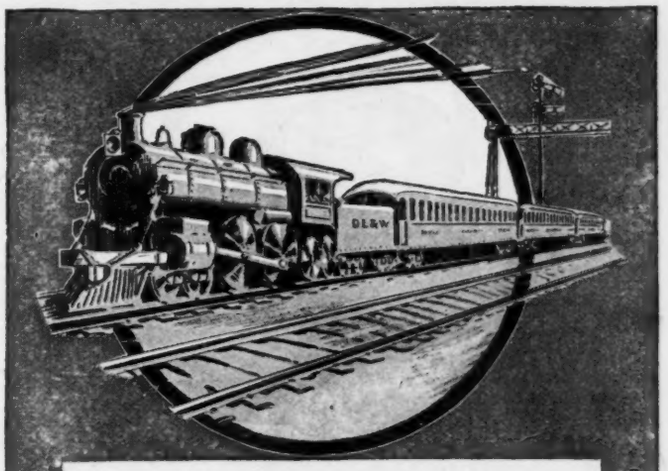


A Flooring That Will Outlast the Plant

Irving Subway laid in the streets of New York ten years ago—with tens of thousands of people walking over it daily—shows no appreciable wear. It still has its safe, comfortable, non-slipping surface—is as solid and firm as the day it was laid. Then—can you imagine that any service you can give it in your plant will ever wear it out—ever make it anything but a safe, comfortable flooring? When you buy **Irving Subway,** you're making a permanent investment with no known limit to the period over which it will return high dividends in comfort, safety, and all-around satisfaction. You ought to read Catalog No. 2A4.

IRVING IRON WORKS CO.
LONG ISLAND CITY, N.Y., U.S.A.
Manufacturers of

IRVING SAFSTEP
TRADE MARK
(PATENTED) REG. U.S. PAT. OFF.
ABSOLUTELY NON-SLIPPING ALWAYS



In Railroad Service

An instance of the durability of *VUL-COT* Fibre in railroad work is shown by the experience of the P. & L. E. E.R.R., a branch of the N. Y. C. & H. R.R. They installed 6000 *VUL-COT* shims at McKees' Rocks on a line that has to stand the daily pounding of at least 16 freight trains. At the end of 7½ years of service only 60 required replacing.

VUL-COT FIBRE
(a higher development of vulcanized cotton fibre)

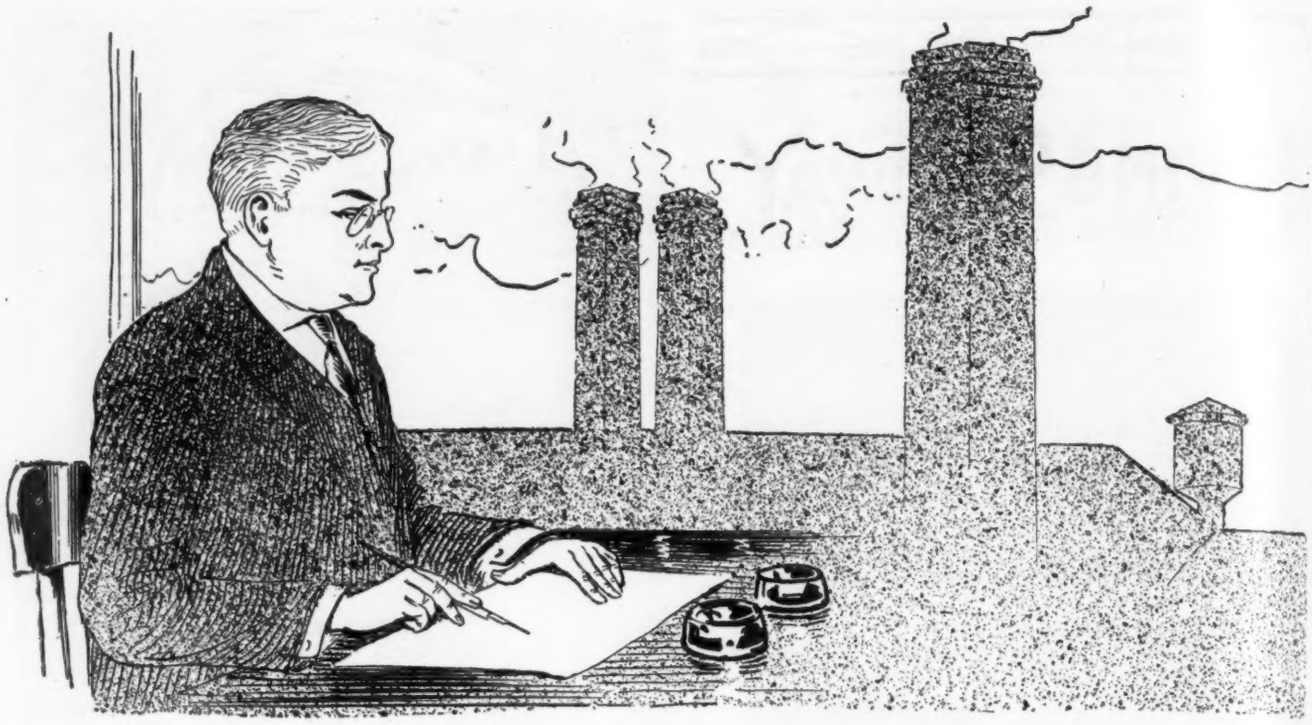
is hard and tough—no ordinary force will crush, break or split it. It will not corrode nor will it deteriorate with age. It can be turned, tapped, threaded, drilled, stamped, cut and sawed with even better results than wood.

For all sorts of electrical and mechanical parts *VUL-COT* Fibre is the best and most economical material to use.

A full description of *VUL-COT* Fibre is contained in our booklet, "The Material of a Million Uses." Send for it.

VUL-COT Fibre is sold in sheets, rods and tubes or machined to specifications.

AMERICAN VULCANIZED FIBRE CO.
555 Equitable Building, Wilmington, Del
SALES OFFICES
BOSTON NEW YORK PHILADELPHIA PITTSBURGH CLEVELAND DETROIT CHICAGO ST LOUIS
Complete Stock for Immediate Shipment at Chicago
Western Agents — *Western Electric Company* — SAN FRANCISCO PORTLAND SEATTLE LOS ANGELES OAKLAND
Canadian Agents — *Northern Electric Company* LIMITED — MONTREAL TORONTO WINNIPEG OTTAWA HALIFAX CALGARY REGINA VANCOUVER



Write Turner Baffle Walls

Produced exclusively by The Engineer Company

into your specifications now

NO matter what your experience with baffles has been—you can not *know* how good a baffle can be—or what a baffle can do for you in the way of saving fuel, increasing boiler capacity, and utilizing a larger percentage of the heat units contained in the burning gases—until you install Turner Baffle Walls in your own boilers.

If you want a *perfect* baffle, built into the boiler, specify Turner Baffles.

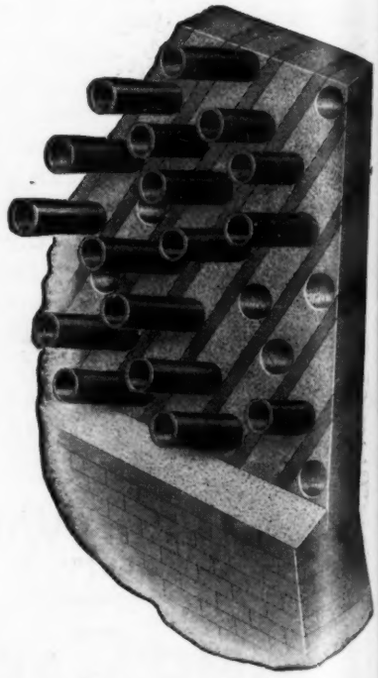
If you want a baffle that is gas tight and air tight under tremendous temperatures, specify Turner Baffles.

If you want a baffle that can be built at the correct theoretical slope, without limitations as to angles, specify Turner Baffles.

If you want a baffle that will permit you to easily withdraw any tube for repairs when cold without breaking down the wall, specify Turner Baffles.

If you want a baffle that will not crumble, crack, crawl or sprawl under extremes of heat or cold, specify Turner Baffles.

And don't forget to send today for our booklet "The Development of an Idea." It gives you the facts, tells of the big power producers who are using Turner Baffle Walls, and it is sent to you on request without obligation.



"Tight as a Drum"

The Engineer Company

17 Battery Place Balanced Draft New York City

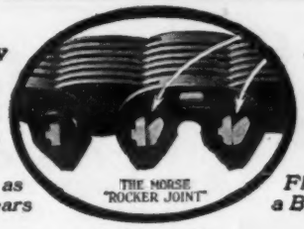
Produced exclusively by The Engineer Company

Branch Offices:

Boston Buffalo Chicago Cleveland Pittsburgh Philadelphia
Minneapolis Montreal St. Louis Hazelton, Pa

The Drive of Efficiency *The Drive of Durability*

MORSE CHAINS



Positive as Gears *Flexible as a Belt*

Longer Life

"Transmissions should be seen—Not HEARD"

MORSE Engineers believe in this so they designed the MORSE SILENT CHAIN DRIVE.

Study the principle of MORSE silent chain drives and you will be convinced of their 99% efficiency.

Are you confronted with problems of Motor Drives with short centers or in Dust, Gases, Acid Fumes or Steam? MORSE drives are your solution.

Is the arrangement of your power peculiar? Write to MORSE engineers and let them extend to you their wide knowledge and experience with chain drives.

Send your orders in early, as our production capacity has not kept pace with our increasing business. We are building and enlarging as rapidly as possible.

MORSE CHAIN CO., Ithaca, N. Y.

Largest Manufacturers of Silent Chains in the World

MORSE ENGINEERING SERVICE **Address Nearest Office** **ASSISTANCE WITHOUT OBLIGATION**

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Dependable control

Electric Furnace

The controlling link in proper power distribution.

Transformers

The rugged construction that experienced workmen assure.

The Packard Electric Company
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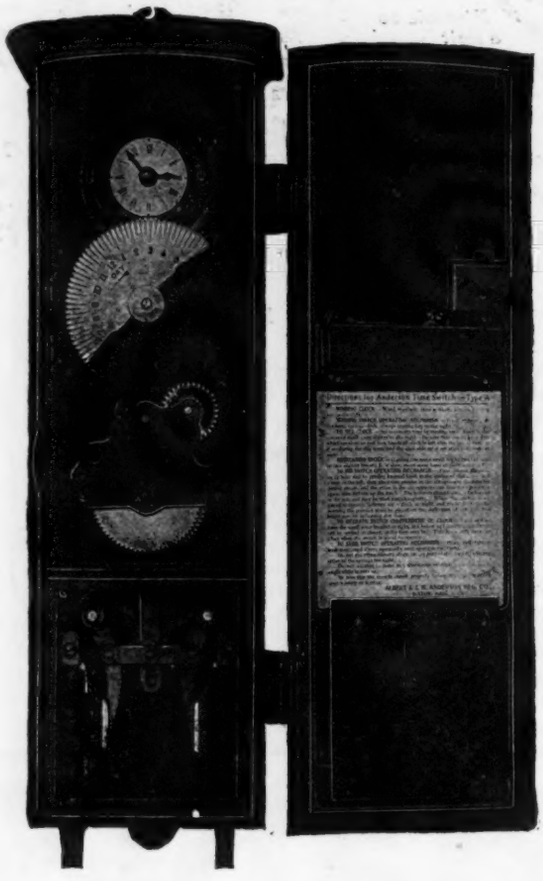
Turn Your Lights On and Off with an



ANDERSON PRECISION TIME-SWITCH

The accuracy, efficiency and economy of using our Type F Time-Switch for the control of lighting circuits over personal control by patrolmen has been conclusively proven by many large lighting companies adopting them.

The clock as well as the operating parts of the switch are of *Anderson* make which in itself is a guarantee of the highest quality.

Why not reduce *your* operating expense by installing Precision Time Switches?

Catalog on application

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289-293 A St., Boston, Mass., U. S. A.

ESTABLISHED 1877

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Walger Connectors

IN these days of high prices these compact, simple, easy-to-use devices bring you an economy worth while. They save time, cut connection costs on every job of interior wiring.

Walger Connectors eliminate blow torch, solder, and tape. They make connections at ½ the cost in ⅛ the time.

Approved

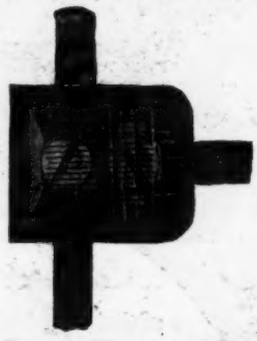
by the National Board of Fire Underwriters and the Hydro Electric Power Commission for No. 12 and all smaller wires.

Send for Sample

See for yourself what Walger can save you—their neatness, completeness, and wonderful efficiency.

Ask your jobber

Phantom View



Phantom View, Actual Size

Walger 3-Way

Use it to tap feed wires in outlet boxes, Condulets and on knob and cleat work. Makes a secure connection, perfectly insulated—it is on in a jiffy.

Walger 2-Way

Any place two wire ends are to be connected, the Walger does it quicker, cheaper, more securely. Practically impossible to connect it wrong; no experience needed.

Actual Size

Made in United States

Walger Connector Company

C. JACKSON, Sales Agent for U. S. and Canada
32 Front St., West, Toronto, Canada

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Goulds Pumps give Satisfaction in the Doehler Plant

The two Goulds Pumps used in the Doehler Die Casting Plant, Brooklyn, are operated night and day against a 140 lb. head, pumping water for general use, they have given satisfactory service.

The extensive employment of Goulds Power and Centrifugal Pumps by engineers and manufacturers is recognition of their sterling qualities.

The design and construction are the result of a half century's experience building practical pumps; And Goulds Pumps possess the strength and efficiency that create satisfactory service. In fact, every Goulds Pump is guaranteed to satisfactorily perform the specific work for which it is sold and there's a Goulds Pump for every kind of pumping service.

Have you a set of our Bulletins ?

The Goulds Manufacturing Co.

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Model M2

KITES RISE

against, not with the wind. No man ever worked his passage in a dead calm and got anywhere.

In soliciting new customers for Duncan Meters, we make a specialty of seeking out those whom we think are unfavorable to our product, and the more prejudiced he is, if at all, the harder we work to reach the goal. Being turned down on our first overture has no discouraging effect upon us whatsoever, and we simply come back more often and with renewed vigor until we succeed in winning him over.

Send for prices and bulletins.

Duncan Electric Mfg. Co., Lafayette, Ind.

MOLONEY TRANSFORMERS

Correctly designed—made of best obtainable material—by skilled workmen engaged exclusively in the manufacture of transformers.

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Where quiet operation is essential

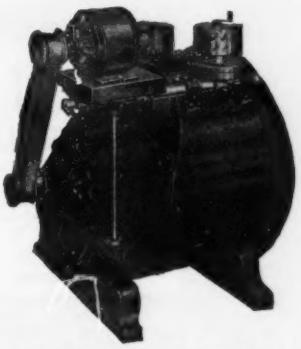
Century

Repulsion Start Induction

Single Phase Motors

are particularly desirable for motor-driven equipment installed in public buildings, schools, churches and residences.

Upon reaching approximately full speed the brushes are automatically removed from the commutator.



¾ HP. 1165 r.p.m. motor direct connected to an organ blower

They Keep-A-Running

Century Electric Company

St. Louis, Missouri, U. S. A.

Sales Offices in principal cities

Dear Boss:

Nearly everyone asks me when the Government is going to step in and put a little low music in the present high cost of living

I tell them if they imagine they can sit back and expect politics to fix things up for them, they're got several thinks coming.

Each man will get a heap farther toward reducing his individual cost-of-living if he will adopt the cure of the Federal Reserve Board, viz: "Work and Save"

Old Nichrome would never have gone very far if we had waited for the industry to bring about its full development. We had to take things in our own hands and you know, boss, how we had to work for it - now it works for us

If we will work as hard and save hard on the living problem, we'll get the thing in hand instead of getting it in the neck as at present

Nyc Chrome

DRIVER-HARRIS COMPANY

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Test the speed of generators, motors, turbines, etc., with our

Jagabi Type "C" Hand Tachometer

This instrument operates on the centrifugal principle, and instantly indicates revolutions-per-minute.

All speed *variations* are shown on the dial immediately, as the pointer is practically dead-beat and very sensitive.

Each part is *balanced,* so that the tachometer may be held in any position without affecting results.

Diameter of dial 3 in. Weight of instrument alone, approximately 18 oz. Case and accessory parts, as illustrated, are included in price.

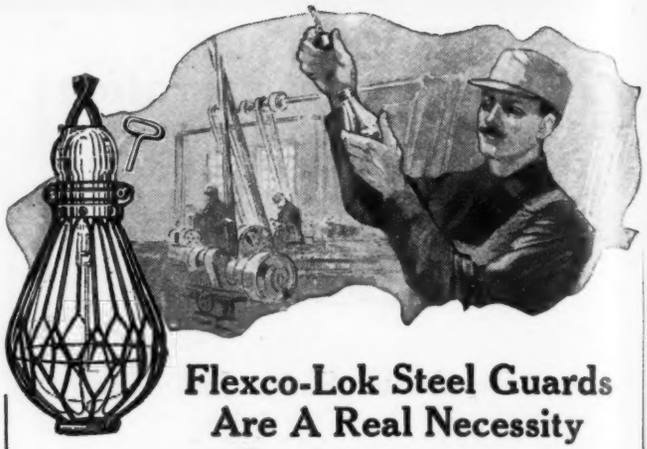
Although three speed ranges are provided, *only one spindle is required*—a great advantage as compared with separate spindles for each range. The change from one range to another is made by a *gear-shifting* device, controlled by an easily-operated slider.

At present we offer the following selection, for prompt shipment:

Range No. 1:	**60-240, 200-800, 600-2400 r. p. m.**
Range No. 2:	**100-400, 300-1200, 1000-4000 r. p. m.**
Range No. 3:	**150-600, 500-2000, 1500-6000 r. p. m.**
Range No. 4:	**300-1200, 1000-4000, 3000-12000 r. p. m.**

Write for descriptive Circular 394.

JAMES G. BIDDLE
1211-13 Arch Street, Philadelphia



Flexco-Lok Steel Guards Are A Real Necessity

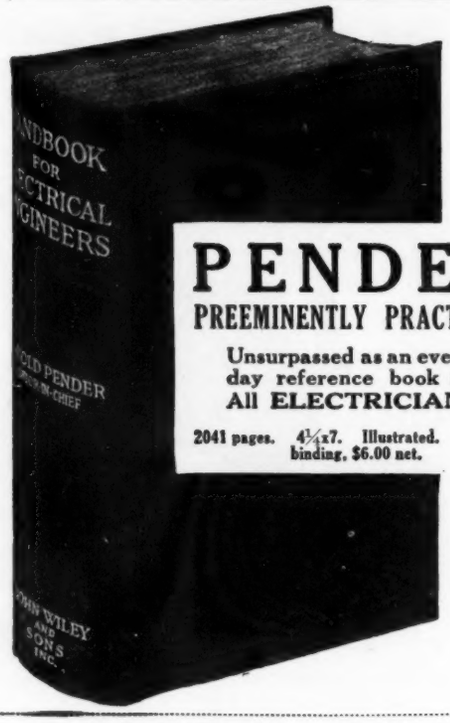
Electric lights by their very nature are fragile and easily broken. The sharp "bang" of a breaking bulb is a familiar sound in every shop and factory. Every broken lamp means a definite loss and increases the overhead expense. FLEXCO-LOK Expanded Steel Lamp Guards cut this waste to a minimum.

The FLEXCO-LOK Lamp Guard is made of expanded steel, well coated with tin. It is easily adjusted and is LOCKED with a key. This prevents unauthorized removal.

FLEXCO-LOK Lamp Guards safeguard your employees and the work in progress from the danger of broken glass. They reduce the fire hazard.

A single broken or stolen lamp costs more than a guard. Ask your dealer or write for catalog and prices.

Sole Manufacturers
FLEXIBLE STEEL LACING CO.
Also manufacturers of
Alligator Steel Belt Lacing
522 South Clinton St. Dept. L G-20 **CHICAGO, ILL.**



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FRAHM PORTABLE

Frequency Meters

(Vibrating Reed Type)

For use in laboratory testing or the outside installation of generators and other electrical equipment, Frahm Portable Frequency Meters have, over a long period, proved their reliability and general usefulness. They are supplied with single or double ranges to care for all usual frequencies; and each instrument is adapted for use on any voltage from 50 to 300.

The construction of these instruments is unique. No moving systems with springs or other delicate parts are employed, so that they are unsurpassed in ruggedness, and also maintain initial calibration indefinitely. They consume a very small amount of energy, and are not affected by temperature change or wave form.

Switchboard Frequency Meters of the Frahm type are also available for permanent mounting.

Full particulars of all types will be found in our illustrated Bulletin 816.

Another important Frahm instrument is our **Vibrating-Reed** Tachometer for permanent attachment to turbines and other machines that run at speeds between 900 and 12,500 r.p.m. Hundreds of these indicators are giving satisfactory service every twenty-four hours per day.

Write for Catalog 856 for full description of these Tachometers.

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DAL BARTH

In the Far East anyone who leaves the village and stays away several years must provide a feast or DAL BARTH for the heads of the village families when he returns.

The return to "the old spot" is always a reunion on a grand scale.

You know, there's something soul-resting to get back amongst the old boyhood joyhood surroundings. You sort of relax—like ashes.

It's the same as when a man has forsaken Morganite and put some cheap carbon brushes on a machine.

He's tense all the time in the knowledge that something is going to happen.

After a few happenings he decides to go back to Morganite—he does—he relaxes— he's again back home—enjoying an electrical Dal Barth.

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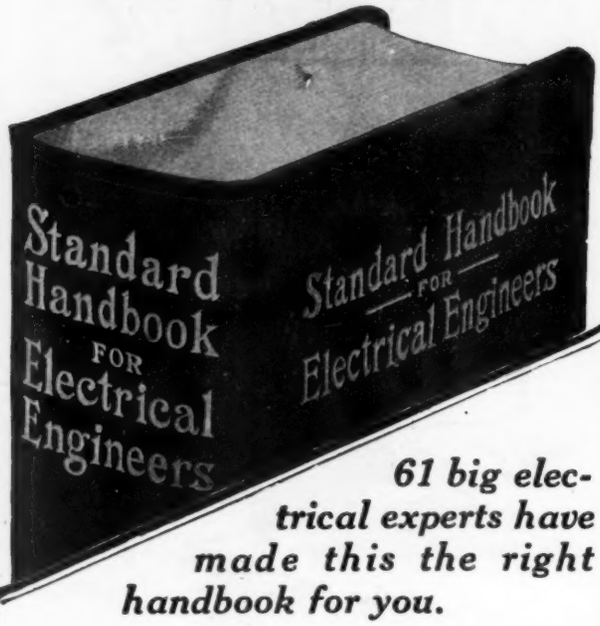

61 big electrical experts have made this the right handbook for you.

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(PATENTED)

For Fractional H. P. Motors

The factor of safety of a motor or motor driven machine is no higher than the factor of safety of the weakest part entering into its construction. Which dictates the necessity for a fine balance of quality throughout, and emphasizes the fact that no part is a "minor part."

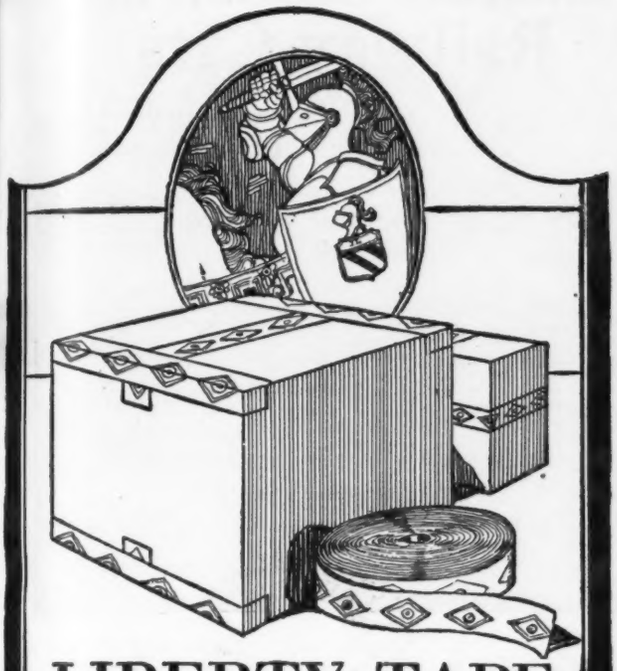
The proved service capacity of "NORMA" equipped magnetos and lighting generators—their high factor of safety to which the "NORMA" factor of safety contributes bearing dependability — have made them to be accepted standards in machines in which maximum serviceability is the dominant idea.

See That Your Motors Are "NORMA" Equipped

THE NORMA COMPANY OF AMERICA

1790 BROADWAY NEW YORK

Ball, Roller, Thrust and Combination Bearings



LIBERTY TAPE

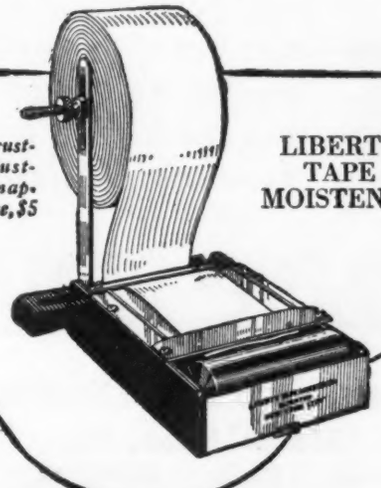
Plain—binds and seals
Printed—advertises as well

Commercial competition is keen in the electrical field. Fasten your identity in the public eye. Big Business everywhere is using private *printed* sealing tape on fibre and corrugated shipping cases to reduce cost and to utilize a hitherto neglected advertising field.

Liberty Tape reduces shipping overhead with a lower container cost, labor cost and shipping weight—makes cases moisture proof. *Printed*, it features name or trade-mark—helps locate stray shipments—identifies cases at terminals—seals them against petty theft.

Liberty Tape is a 2-in-1 profit maker—it cuts cost and capitalizes a great advertising waste. Estimates and color designs gladly made.

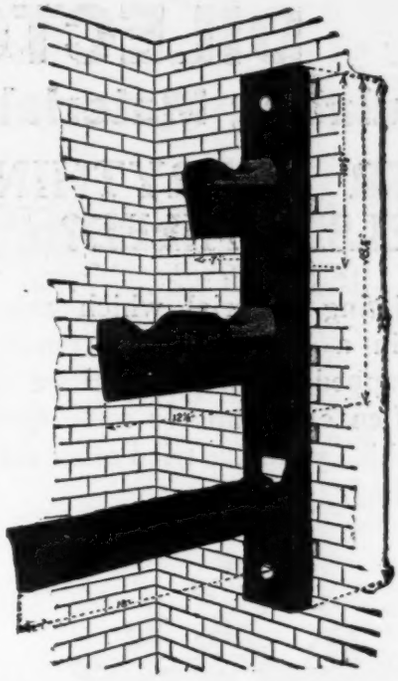
LIBERTY PAPER COMPANY
52 Vanderbilt Avenue New York City
Mills: Bellows Falls, Vt.



Sanitary, rust-proof, adjustable. Sent on approval. Price, $5

LIBERTY TAPE MOISTENER

PROTECT YOUR CABLES



against burnouts and electrolysis.

Metropolitan Subway Cable Racks

are the only kind which insulate the cables from the manhole. Moving or repairing of cables is made easy—simply slip out the porcelain insulator and lift the hanger from its slot by raising the cable one-half inch.

Metropolitan Engineering Co.

1250 Atlantic Avenue, Brooklyn, N. Y.

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Protection First

METROPOLITAN ENGINEERING CO., 1250 Atlantic Ave., Brooklyn, N. Y.
Please send your latest data on Subway Equipment. It is understood that this incurs no obligation.

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Did You Ever Try BAKELITE DILECTO

Insulating Material

AFTER EVERYTHING ELSE FAILED?

An insulating material which can be worked in a lathe or other machine, drilled, tapped or threaded; fills a need which often crops up for some special job, on which you have tried other things which failed.

CONTINENTAL

For Factory and Repair Shop

it has so many and widely varying possibilities that a supply of sheets, tubing and rods in a range of sizes should be kept in stock.

It has a dielectric strength of 700-1500 volts per mil,—

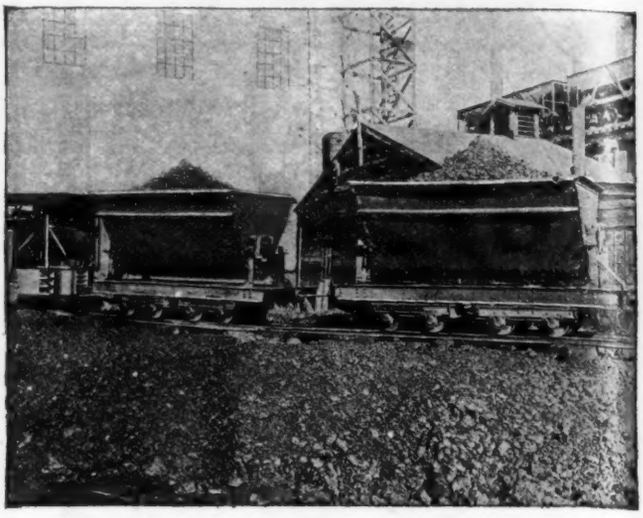
What does that mean to you?

The Continental Fibre Co.
Newark, Delaware

CHICAGO, McCormick Bldg. NEW YORK, Woolworth Bldg.
Pittsburgh Office—Commonwealth Bldg.
San Francisco Office—Underwood Bldg.
Los Angeles Office—I. W. Hellman Bldg.

Manufacturers of High-Grade Vulcanized Fibre

Easton Industrial Railway Cars



Obvious Advantages

A man can handle twice as much material in a wheelbarrow on a smooth, clean, concrete floor as he can on an earth floor, and about 18 times as much as he can on sand.

Without multiplying cases the advantages of the steel to steel contact of Industrial Railway Cars and Track must be obvious. Especially so if the cars and equipment are properly designed and installed.

This Company's quarter century of manufacturing specilization and the services of its engineering force will assure for you the highest type of Industrial Railway.

EASTON CARS

EASTON CAR & CONST'N CO.

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Works: Easton, Pa.

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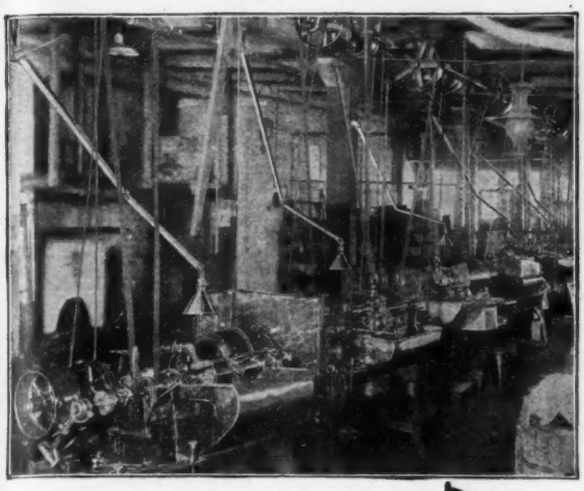

Boosting Production

That is the big thing that American Adjustable Fixtures accomplish when installed in your machine shop or factory. They bring the light to the work and enable higher intensities at low cost.

The "American" Fixture can be used for lighting any kind of work. Its construction is very substantial. All conductor wires are enclosed in the fixture arms. The universal joints enable the fixture arms to be moved in any position—and they stay put.

6 STYLES
Ceiling Fixtures
Wall Brackets
Floor Fixtures
Bench Fixtures
Machine Fixtures
Portables

Write today for details on the "American"

AMERICAN FIXTURE CO.
A. C. Runkel and Ed. R. Kiesslich, Proprs.
230 W. Water St., Milwaukee, Wis.

Die Castings for all Purposes

This Company has made many millions of die castings. Orders recently completed were for over 25,000,000 bouchons for hand grenades for the U. S. Government.

Equipment is ample; furthermore, it is backed by a personnel of long experience and great skill in the art of die casting.

Perfect coordination of this organization with your engineering department combines our knowledge of die casting with your own close study of your manufacturing requirements. The result is die castings that serve their purpose practically 100%.

Send blueprints or models, and let our engineering department show you how precision Castings can serve economically and efficiently.

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SYRACUSE. PRECISION CAST NEW YORK.

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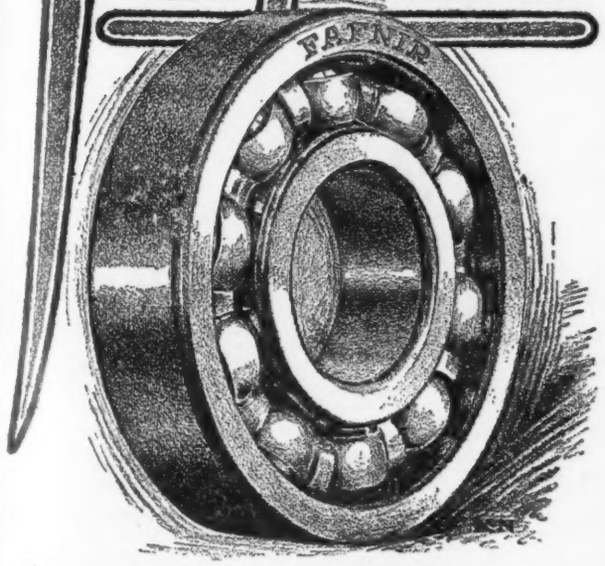
Brass, Bronze and Aluminum Foundry, Pontiac, Mich.

Fafnir



Dependable Ball Bearings

THE FAFNIR BEARING COMPANY
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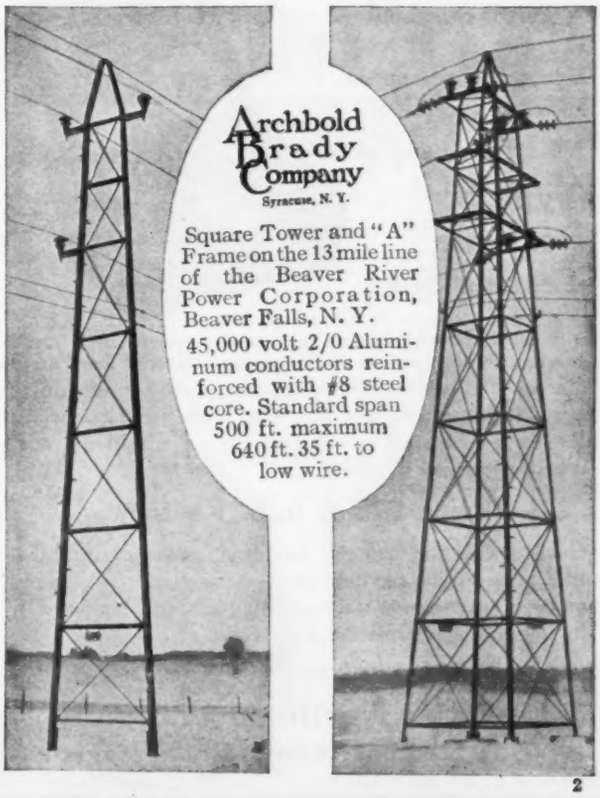
Modern Construction


Archbold Brady Company
Syracuse, N. Y.
Square Tower and "A" Frame on the 13 mile line of the Beaver River Power Corporation, Beaver Falls, N. Y.
45,000 volt 2/0 Aluminum conductors reinforced with #8 steel core. Standard span 500 ft. maximum 640 ft. 35 ft. to low wire.

2

PERU

Here is another example of the class of porcelain parts which we are equipped to make. This particular piece is a porcelain pot head used in ornamental street lighting standards where the underground cable connects to the street lamp leads.

We are equipped to take care of your porcelain requirements either standard or special. We can also furnish brass and porcelain parts assembled for electric wiring appliances.

Let us show you what we can do for you.

Standard and Special Porcelain Electric Wiring Appliances

PERU ELECTRIC COMPANY

PERU, INDIANA

THE ONLY SCREW HOLES IN THE WORLD

You drive the screw holes with a hammer in any material.

The screw holes are made for wood screws or machine screws to fit all sizes of screws. The head is removed and you leave a permanent screw hole.

The Stine Screw Holes Co.

Once a Screw Hole, Always a Screw Hole

Manufacturers
WATERBURY, CONN., U. S. A.
DEPARTMENT 13

The Biggest Little Thing in the World

Some of the Reasons Why Screw Holes Will Be Bought and Used and Not Become Dead Stock for Anyone

1—They can be used without damage to receiving material.
2—They enable you to standardize to wood or machine screws in all material.
3—They are made of brass and will not rust under atmospheric or moisture conditions.
4—ECONOMY—They save more time value than the holes cost.
5—You get them for nothing and are paid for using them when you count time saved.
6—Screw holes have been needed ever since the first screw was used.
7—Special tools are NOT needed in using them in any material.
8—They can be used in any place a screw can be used.
9—By using screw holes, screws can be used in many places, and in many materials where it is impossible to use screws without them.
10—These are the only ready-made screw holes in the world.
11—No special screws are needed. These screw holes fit any wood screw or machine screw now in stock.
12—They make the neatest possible job in any material.
13—Every store where screws are sold must carry them in stock, because the line of screws is not complete without screw holes for them.
14—Every shop and factory where screws are used must also have these screw holes to fit the screws.
15—They are endorsed by all dealers in screws and by all users of screws.
16—Screw holes are entirely new and the world supply is yet to be furnished.
17—This is a progressive Old World of ours and every active person in it must adopt all improved methods, and all new articles that will help him keep in the front line of progress.
18—Be among the first to stock up in screw holes if you are a dealer in screws.
19—Be among the first to install screw holes in your shop or factory, as you begin to save money soon as you use them.
20—In spite of the high cost of brass, screw holes are yet cheap.
21—We are letting the world know that screw holes can now be secured, by means of extensive advertising in all the principal Trade Journals that have the largest circulation among dealers in screws as well as users of screws.
22—Do not let your customer ask you for screw holes before you have them in stock. BE A LIVE WIRE.
23—They make everlasting holes in any material.
24—They mean "Plug-No-More" screw holes.
25—They are the result of Necessity being The Mother of Invention.
26—Anyone who can drive a nail can use screw holes.
27—Send for a sample and convince yourself.
28—Mechanics who see them say, "What do you think of that?"
29—In fact there are NO REASONS why screw holes should NOT be used.

Each of these reasons is enough to sell Screw Holes. There are many other reasons. Write at once for our handsome Color Card showing screw holes in various materials which will be sent on request, together with samples and price list.

Resistance Measurements

This is to remind you that for all resistance measurements in field or shop, the

Type S Portable Testing Set

is a most convenient and trustworthy instrument. Dial construction, simple to use; contacts protected from dirt, but easily accessible. Rheostat coils, 1/10%, ratio coils, 1/20%, guaranteed accuracy, high grade resistance wire. Rugged, suspended coil galvanometer, sensitivity one microampere per division.

Price $75 f. o. b. Factory

Good design and quantity production make possible the low price at no sacrifice of workmanship. The guarantee of satisfaction accompanying all our high grade instruments applies to the Type S set.

Bulletin W530 awaits your request.

Leeds & Northrup Company
4901 Stenton Avenue, Philadelphia

TUNG-SOL Miniature Lamps

G-8

We invite your inquiries on all types and sizes of miniature incandescent lamps.

Miniature Incandescent Lamp Corporation
Licensed Manufacturers of Incandescent Lamps
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EAGLE
Renewed Tungsten Lamps

give more than twice the light of carbons at same current cost!

First cost no more than new carbons.

Write for prices and further information.

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National Lamp Works of General Electric Co.
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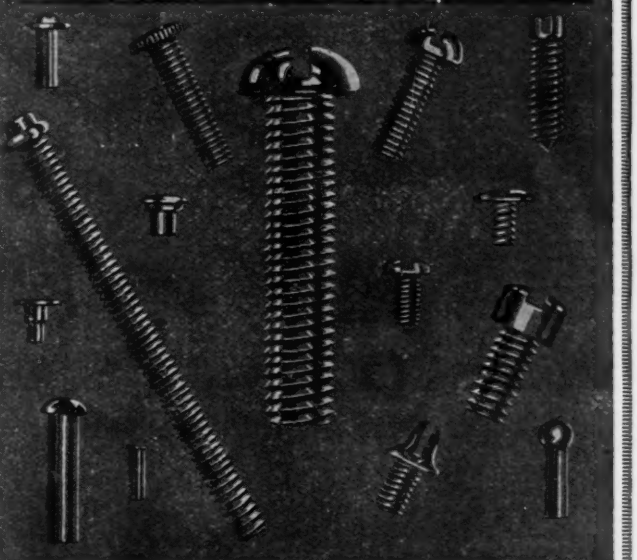
IF YOU BUILD SWITCHBOARDS

You use large quantities of screws and threaded studs in copper, brass and iron.

To insure proper electrical and mechanical strength these must be accurately made.

Why not let us quote you on these items?



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Since 1849
Waterbury, Conn.

At Last! !
A Precision Tachometer
The Van Sicklen Chronometric
The Tachometer Timed by an Elgin Watch

Gear Driven
Hand Dead Beat
Not Affected by Changes of Temperature or Pressure
Free from Lag
Operates in Either Direction
Universal in Application
Reads 20 to 2500 r.p.m. on Dial
Accurate Within 5 r.p.m. on Total Scale
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For Full Description Send for Bulletin 81X.

Central Scientific Company
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WOOD STAVE PIPE

This pipe can be placed underground, below plow depth. It cuts off all waste of water by evaporation or seepage, and besides, saves right of way expense across ground owned by others who do not want it cut up by ditches.

Our engineering staff is maintained for your convenience.

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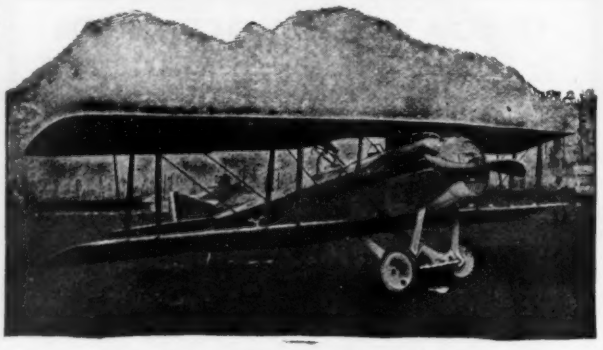

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Beldenamel
TRADE MARK

Magnet Wire, in the successful operation of the tiny pursuit planes used in the war. The magnetos furnished for the SPAD and other planes, by the

Societé S. E. V. (Renault Frères)

required the best magnet wire procurable. Beldenamel was adopted as the standard, and in spite of submarine warfare, regular shipments of Beldenamel went forward for these all-important windings.

Samples and prices on Beldenamel and other magnet wires will be quoted on application.

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NITROGEN WHITELITE LAMPS

Do you know why the WHITELITE is an exceptional lamp?

It is because come-backs are of the rarest exception with WHITELITES.

Ask our customers of long standing. They are many and everywhere.

And then ask us for prices.

WHITELITE ELECTRIC CO.
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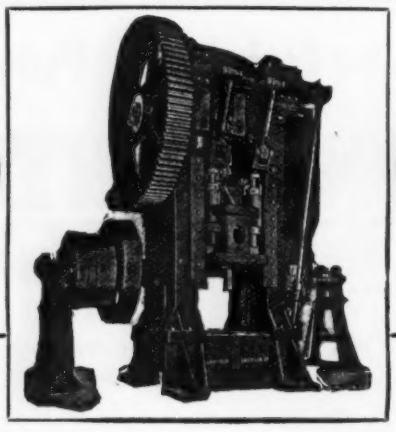
BLISS BLISS



The Uniform Pressure Makes Every Piece a Good Piece

The Bliss patent toggle motion exerts a uniform pressure and the work produced is smooth and uniform. This action also facilitates the work and requires less power.

The blank holding pressure is taken by the frame, thus relieving the bearings.

Bliss Toggle Drawing Presses

The blank holder starts on its upward movement nearly simultaneously with the punch, giving the operator ample time for removal of drawn piece. Bliss Toggle Drawing Presses are built in many sizes and cover every requirement.

Let us send you descriptive matter covering your exact requirements. Write today.

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Chicago office: Peoples Gas Bldg. Detroit office: Dime Bank Bldg. Cleveland office: Union Bank Bldg. Offices in Europe: 100 Blvd. Victor Hugo, St. Ouen (Paris), France; Pocock St., Blackfriars Road, London, S. E.

2

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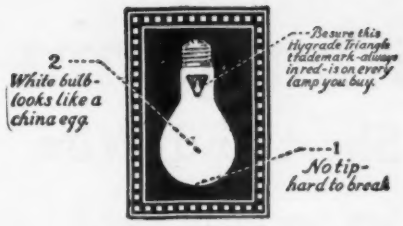
WATER WHEEL GOVERNORS
Woodward Installations the World Over
In nearly every corner of the globe Woodward Governors are safeguarding not only the efficient and reliable operation of the water wheels which they control, but the reputation of the Woodward organization as well. Over 50 years of governor-building experience are behind that name—Woodward Governors must uphold its significance; and they do
"Leadership Founded On Service"
Woodward Governor Co.
* Rockford, Ill., U.S.A.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White bulb-looks like a china egg
Be sure this Hygrade Triangle trademark-always in red-is on every lamp you buy.
1
No tip-hard to break

A New Lamp

that you can sell to almost everybody.

A WHITE lamp which cannot break easily because it has no tip—and does not dazzle the eyes because it *glows* instead of glares.

WHITE Hygrade C-4

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The bulb is made of white glass like fine china or porcelain. It is easy on the eyes, yet gives a strong light.

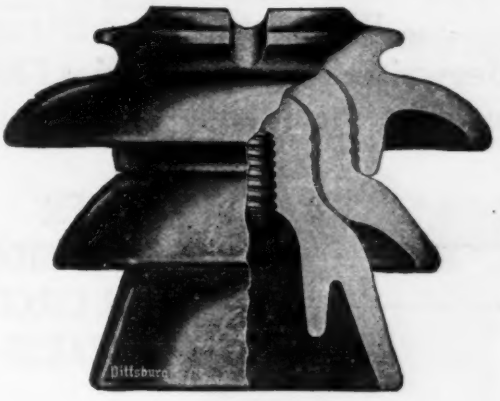
The WHITE Hygrade C-4 lamp makes possible at low cost soft, artistic lighting effects.

It saves eyesight because it does not strain the eyes—and because there is plenty of light without dazzle, makes a splendid working light for the housewife and for all who do fine work. Should be used in every fixture where the lamp is exposed to the eye.

HYGRADE LAMP CO

GENERAL OFFICE AND FACTORY SALEM MASS

"PITTSBURG INSULATORS"



Export No. 371 for 45,000 Volts will give you a line where you will not be troubled with interruptions.

The Pittsburg High Voltage Insulator Co.

Main Office and Factory, Derry, Penna.
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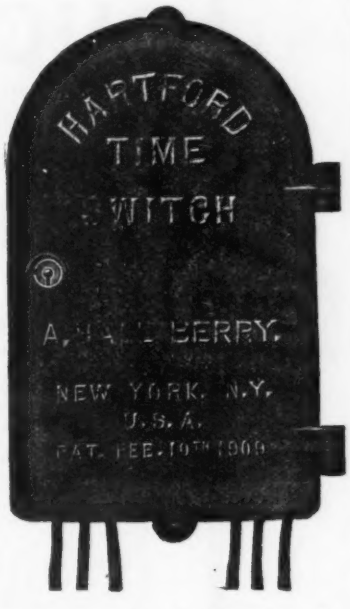
Harmon S. Salt, 114 Liberty Street, New York, Export Agent.

"I Never Forget"



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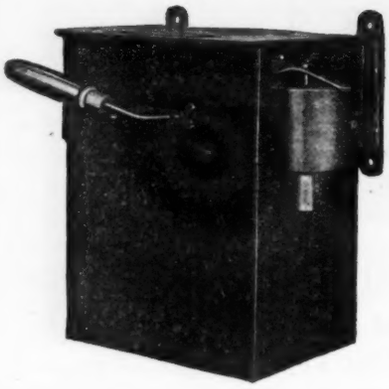

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—the ultimate of 7 years' trial and proof

Overload, Automatic, No Voltage and Manual. Approved up to 20 H. P., 440 Volt, $22.50.

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Sheet and Wire

We have been manufacturing this alloy with satisfaction for more than one year and can supply it in all shapes and sizes from large sheets down to very fine wires. The care with which it is made ensures uniformity of product. For high-class instruments its low temperature coefficient of resistance and thermoelectromotive force against copper render our alloy superior to any previously procurable.

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in all forms for all purposes
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LOWEST UNIT COST
OF OPERATION POSSIBLE
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The material you wish to handle is best moved with Orange Peel or Clam Shell Buckets.

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will give a better service than is possible with the average bucket.
There is a positive "bite" into the material—be it Coal, Sand, Gravel, Crushed Stone or Dirt—and every bucketful will measure up to the rated capacity of the bucket.
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Highest quality and good service.
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All coils made according to specifications and guaranteed to be satisfactory.

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Plain enameled copper wire
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We carry large stocks on hand, and can make prompt deliveries of the best grade wire.

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Twenty-one years of success

Self Lubricating
Noisless
Non Cutting
No Care
No Friction
Low Resistance
Copper Plated

Average Life, 10 Years

24-Hour Emergency Service

We will submit brushes for trial, any size and any quantity to new users.
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Graphite Products Company
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H. M. WARD, President Factory: 5155 Wakefield Street

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For Every Pole Purpose

Cut shows Bates Steel Towers in use by Consolidated Water Power & Paper Co., Grand Rapids, Wis. This structure is 70 ft. high and acts as dead end for six heavy conductors on 1000 ft. span. It evidences the broad range of adaptability of Bates Steel Poles. Our slogan "STEEL POLES FOR EVERY POLE PURPOSE" is most fitting and appropriate. Bates Steel Poles are becoming universally popular world wide. Repeat orders testify their general suitability for every Pole purpose.

Telegraph
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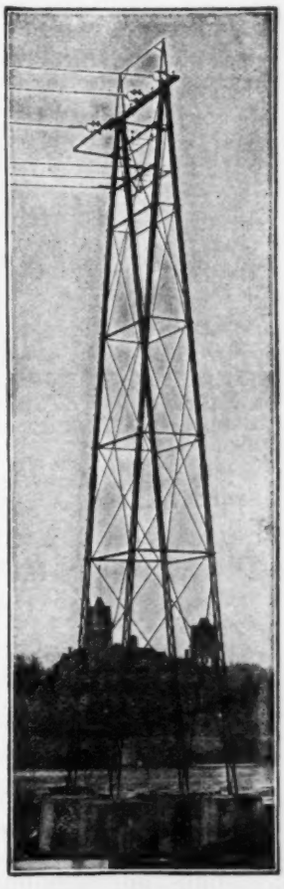
Highest class and most up-to-date steel pole equipment in the world. Our STEEL POLE TREATISE tells the story. Ask for it.

About 2,000 tons of steel constantly on hand; immediate shipments and lowest prices.

Tubular Steel Poles cost 50% more than Bates Steel Poles, yet Bates Poles are 100% stronger —will last 100% longer, cover a much broader range of adaptability and are much more artistic than Tubular Poles. Ask us to verify these facts.



Bates Expanded Steel Truss Company
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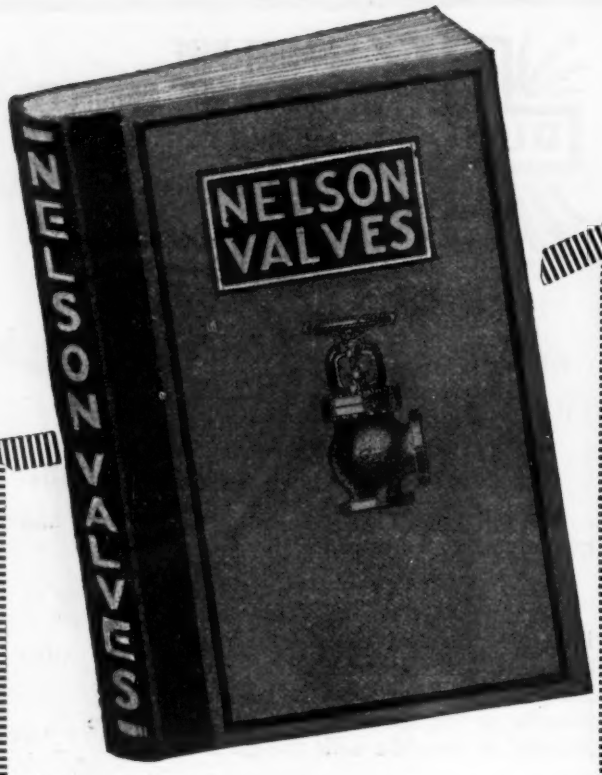

The New Nelson Catalog is now ready for you

The new NELSON catalog—just off the press—should be in the library of every valve user and buyer. It contains complete descriptions of the entire NELSON line of quality valves.

NELSON VALVES are GOOD valves. Behind them is an experience of more than twenty years of engineering skill during which time the aim has always been to produce valves of superior merit. There are many distinctive features in NELSON VALVES which make them readily appreciated by engineers and plant managers.

There are

NELSON VALVES

for practically every purpose

NELSON VALVES are made in Steel, Iron and Bronze and in Globe, Angle, Check and Non-Return types. They are designed RIGHT and made RIGHT.

Now—while the matter is fresh in your mind—send for your copy of the new NELSON catalog.

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Pittsburgh, Jenkins Arcade. Cleveland, Rockefeller Bldg. Minneapolis, Andrus Building.

Representatives in other large cities.

NELSON VALVES
"a safe valve investment"

Electroduct

The Perfect Enameled Conduit

Practice makes perfect—and the perfect Conduit makes good. For over 18 years *Electroduct* has made good.

Made from easy bending Spellerized Mild Steel Tube. Enameled inside and out with specially prepared Black Enamel not affected by weather conditions. Clean Threads. Furnished in 10-foot lengths. Threaded on both ends with coupling on one end.

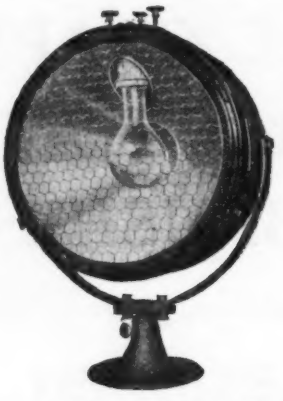
Write for samples.

American Circular Loom Co.
90 West St., New York

Boston Los Angeles Seattle
Chicago San Francisco Toronto

AMERICAN CIRCULAR LOOM CO. TRADE MARK

FLOOD LIGHTING



Economy Outdoor Lighting

Flood Lighting is the **real efficiency** method of lighting large outdoor areas such as industrial plants, railway yards, ship yards, docks, construction projects, etc.

The unit shown is used with a 500-watt Mazda C lamp. It is specially designed to throw a wide angle beam, lighting large areas at short distances.

Let us tell you more about flood lighting for your requirements.

Frederick A. Watkins

DISTRICT SALES AGENT
PITTSBURGH REFLECTOR & ILLUMINATING CO.
565 W. Washington St., Chicago, Ill.

Correspondence Solicited from Sales Representatives

In War or Peace Times—

Cut Out the Waste!

Clean up! Do it NOW! Do it regularly!

Every piece of Idle Equipment, Unnecessary Material or Scrap represents WASTE!

—waste

Money!
Time!
Space!
Labor!
Material!

—the *money* such equipment or material cost earns nothing and is not available for other use.

—the *time* it is idle is wasted when it can render service elsewhere.

—the *space* it occupies costs money and may be needed for other purposes.

—the *labor* of its manufacture is wasted and also the labor of producing a duplicate for the man who *can* use it.

—the *material* it represents would be useful in another form.

Cut out *all* this waste! Don't have material or equipment around that is not needed. Turn it into cash.

There is always a market for either scrap or good used machinery. Conservation of both materials and machinery can be practiced with just as much profit in peace as in war times.

Buyers for surplus material, good used machinery, junk or scrap, can easily be found through the

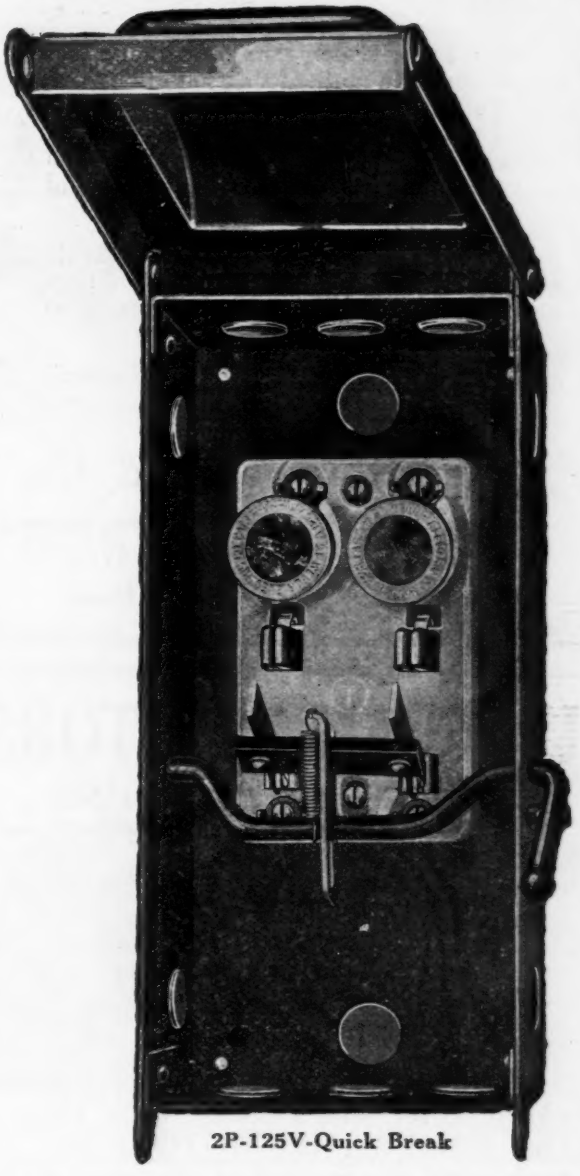
Searchlight Section

413

"Circle T" *Quality at a popular price*

Ⓣ

FIFTY-SEVEN FORTY-ONE



2P-125V-Quick Break

Externally Operated Entrance Switch for Plug Fuses

The price of this Entrance Switch is so low as to furnish no excuse for installing an open entrance switch. This switch is externally operated, fusible top or bottom, quick break—well finished and A-1.

Ask your jobber for prices and information.

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PLAINVILLE, CONN.
New York Chicago Boston Philadelphia San Francisco

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Supplies and Apparatus for Central Stations

so much cheaper than any individual station can buy for itself that our "Purchasing Service" gives our clients all the benefits of collective buying on a large scale with the larger discounts based on maximum quantities and competitive bidding.

We also advise our clients as to probable market conditions and changes and thus enable them to plan their budgets to best advantage.

We will be glad to explain our "Service" plan to you.

Merrill, Sweeny & Co.

ENGINEERS, MANAGERS, PURCHASING AGENTS
FOR PUBLIC SERVICE PROPERTIES
50 STATE STREET, BOSTON, MASS.

Two Views of Protected Disconnection Outdoor (Type D.O.A.) Cable Terminal.

PERFECT protection of cable insulation and ease of connection and disconnection from aerial extensions are two of the distinctive characteristics of STANDARD Cable Terminals.

There are other exclusive features which make these terminals the most economical on the market. Our new Bulletin 700-2 will explain fully. Write for it.

Standard Underground Cable Co.
Pittsburgh, Pa.

Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Detroit, Minneapolis, San Francisco, Seattle, Los Angeles, Salt Lake City

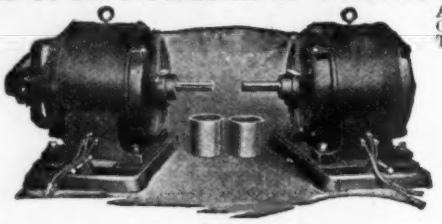
For Canada: Standard Underground Cable Co. of Canada Limited, Hamilton, Ont.

UNIFRAME MOTORS

DIRECT OR ALTERNATING

¼ to 50-H.P. Constant or Variable Speed

Direct Current Type H.



Alternating Current Type N.

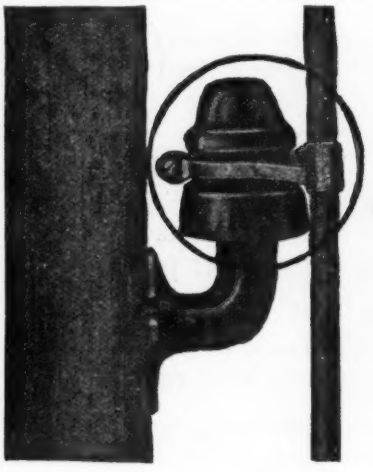
There's a difference between a good, *cheap* motor and a cheap, *good* motor. Our UNIFRAME MOTORS are as reasonably low priced as consistent with the highest grade of materials and workmanship.

Identical frame and base dimensions permit use of either A.C. or D.C. motors on same mounting.

Generously rated, efficient and durable. Guaranteed performance.

Write for Bulletins.

B. A. Wesche Electric Co.
327 East Sixth Street, Cincinnati, Ohio
Eastern Sales Agents, 90 West St., New York, N. Y.



With "Thesco" Vertical Clamps

you can attach vertical wires to line insulators without inviting those mysterious "leaks" which always accompany the shifting of a petticoat insulator from its vertical position.

They are made of malleable iron, hot dip galvanized, and easily installed.

And—they don't cost much!

"Thesco" clamps save you money, current and time.

THE STATES CO.
19 New Park Ave., Hartford, Conn.

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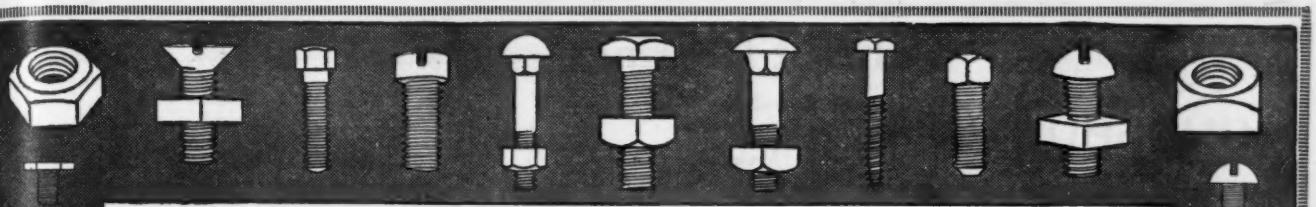

We are prepared to make PROMPT DELIVERIES on LARGE QUANTITY SPECIFICATIONS OF STANDARD PRODUCT illustrated.

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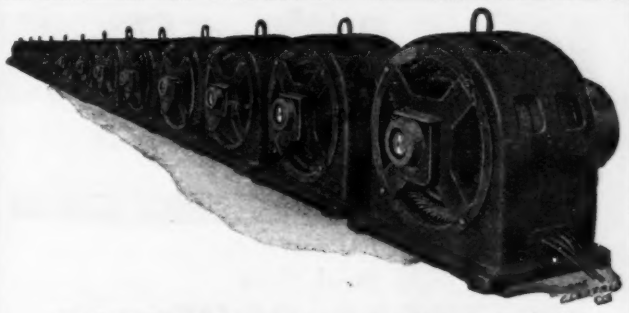
BOLT MAKERS Cleveland, U.S.A. SINCE '96.

"PARAC" Rubber Covered Wire
"O. K." Weatherproof Wire
Bare Copper Wire

Phillips Wire Company
Pawtucket, R. I.
MEXICAN BRANCH:
Cia Mexicana, de Alambre "Phillips," Mexico City



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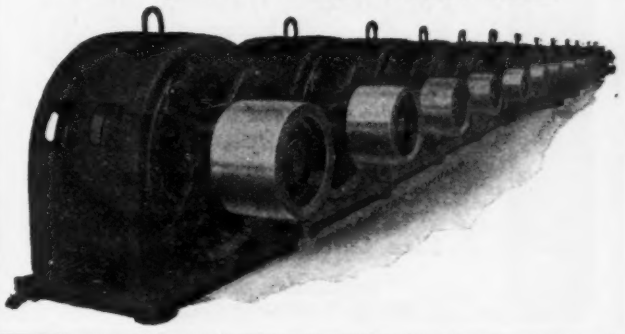
Works: Erie, Pa. Sales offices in principal cities

Motors for all purposes where reliable power is essential.

ALL SIZES ALL SPEEDS ALL VOLTAGES
2 and 3 phase Alternating and Direct Current



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"built like a watch"
for every electrical need
Ask for Bulletins

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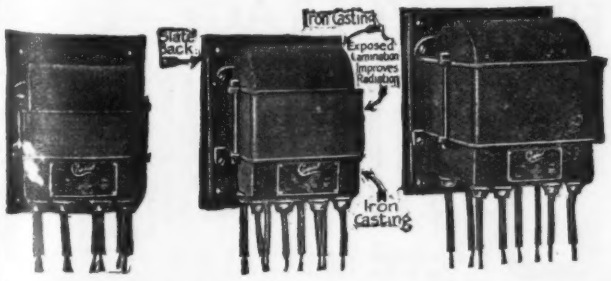

TRANSFORMERS

ARE YOU HAVING ANY TROUBLE IN SECURING PROMPT DELIVERY OF TRANSFORMERS?

Please remember that we can give you GOOD DELIVERY. *ALL SIZES.* ALL VOLTAGES. ANY FREQUENCY. Special transformers for any purpose. The highest efficiency.

CAMPBELL ELECTRIC CO., Main Office and Factories, LYNN, MASS.
Manufacturers, Transformers—for 15 years Manufacturers—X Ray Apparatus
Manufacturers—Time Switches

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KINGSBURY

Thrust Bearings

Maximum Durability — Minimum Power Loss

Negligible Maintenance Cost Minimum Bulk and Weight

The Principle of Operation is Described Below

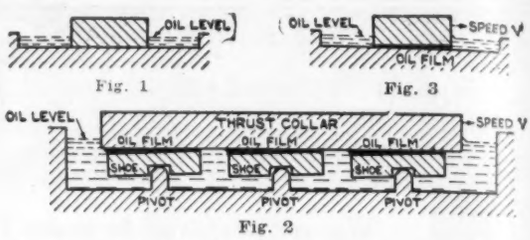


Fig. 1 Fig. 3

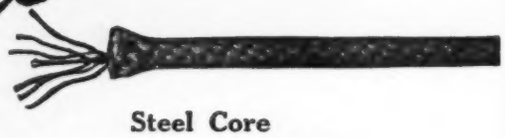
Fig. 2

When one flat surface is pressed against another covered with oil, as in Fig. 1, the oil will be squeezed out from between them. When one is moved along the other, the two surfaces *when free to do so* assume inclined positions, as in Fig. 3, and become separated by a wedge-shaped film of oil. Figure 2 shows one method of applying the above principle in a Kingsbury thrust bearing. It represents a developed section of a thrust collar revolving over pivoted segments or shoes. The shape of the oil film varies with the speed. The film thickness increases with the viscosity of the oil and with the speed. No low speed or high speed limits have yet been reached.

ALBERT KINGSBURY, ENGINEER, OLIVER BLDG., PITTSBURGH, PA.

A-107

Roebling



Steel Core

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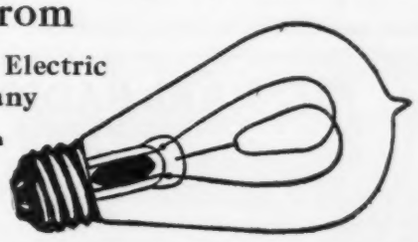

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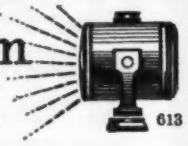

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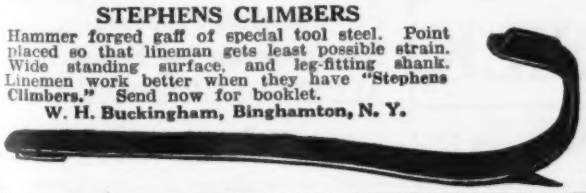

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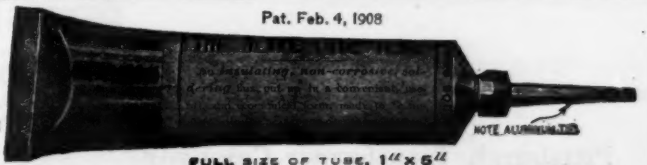

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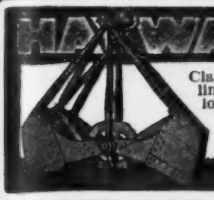

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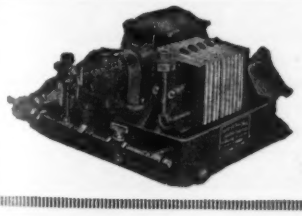

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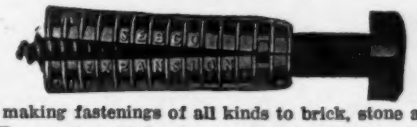

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We specialize on
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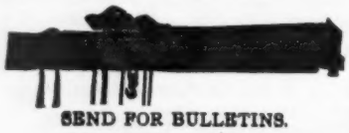

ELECTRIC CRANES
HAND CRANES
ELECTRIC HOISTS
I-BEAM TROLLEYS

SEND FOR BULLETINS.

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Keep Production Steady

After-the-war competition will require highest efficiency—maximum production. And Rothmotors, with more than 20 years' record of few repairs, will help to avoid delays. Write today for complete facts.

Roth Bros. & Co., 1400 W. Adams St., Chicago, Ill.
See our exhibit at the Chicago Electrical Show, Oct. 11th to 25th, 1919.

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The advertisements in the Searchlight Section are constantly bringing together those who buy, sell, rent or exchange.
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The cost is a trifle, the results considerable. 0059

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PURIFICATION SYSTEMS
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FOR BOILER FEED AND
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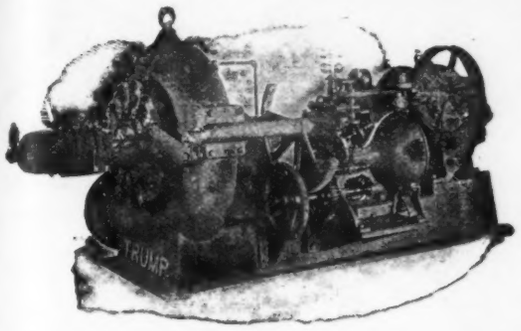

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EFFICIENCY—DURABILITY—DESIGN

are combined in TRUMP TURBINES for the development of

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With an experience of 42 years behind the construction of Trump machinery places us in a position to give advice based upon sound practical experience. Trump Turbines built to suit the conditions, both horizontal and vertical. Let us have your inquiries.

THE TRUMP MFG. COMPANY, Greenmount Ave., Springfield, Ohio

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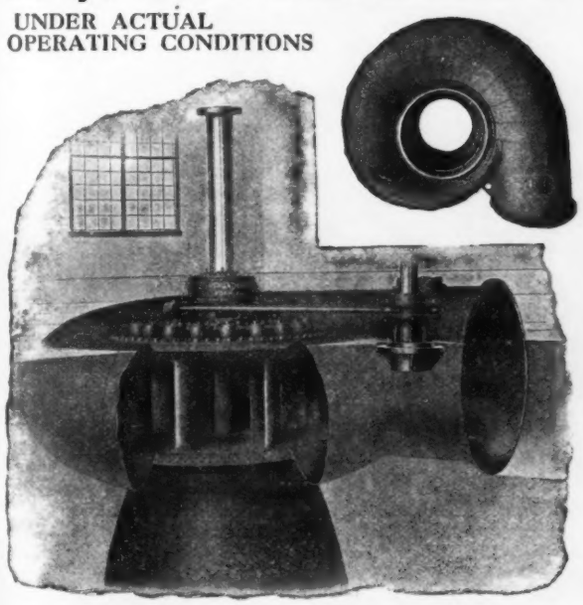
92% EFFICIENCY

UNDER ACTUAL OPERATING CONDITIONS



The accompanying illustration shows a single, vertical shaft wicket gate SMITH HYDRAULIC TURBINE in a plate steel scroll case with all gate operating mechanism on the outside. This unit is in successful operation under 60 ft. head developing 3,000 brake horse power at 240 revolutions. After installation it was tested by disinterested engineers and established the above performance record under actual operating conditions.

Write Dept. "W" for Bulletin of Designs

S. MORGAN SMITH CO., York, Pa.

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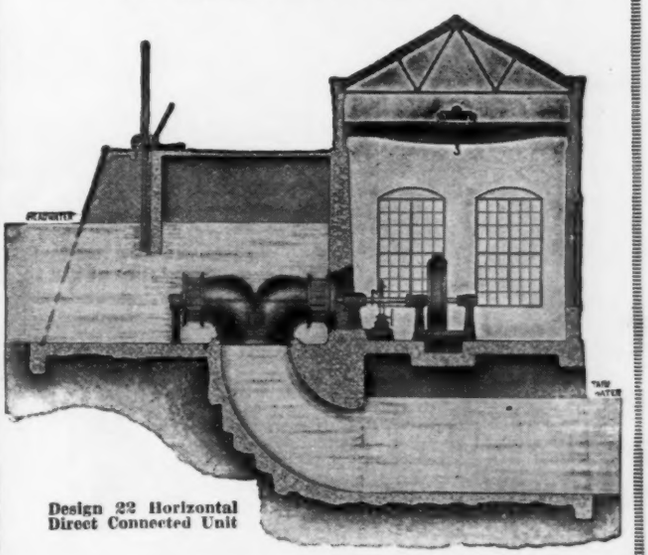
LEFFEL TURBINE WATER WHEELS

HIGH SPEED, HIGH HORSE POWER, HIGH EFFICIENCY VERTICAL AND HORIZONTAL DESIGNS



Design 32 Horizontal Direct Connected Unit

Write for Bulletin 54

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St. Louis Motors are made in Three-Phase, Two-Phase and Split Single Phase, Squirrel Cage Induction Type. Polyphase may be had in twelve sizes, from one-half to twenty h.p.; Single Phase in ten sizes, from one-eighth to two h.p.

These motors are absolutely dependable; have high efficiency, low maintenance cost, ideal performance characteristics and economical price. Send for Our Catalog No. 5.

We urge you to investigate if you are seeking the BEST motor value that the market affords.

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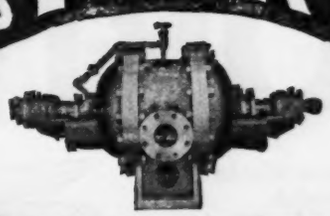

"R.T.U.R.B." CENTRIFUGAL PUMPS - AIR PUMPS
MADE BY MANISTEE
ROTARY JET CONDENSERS

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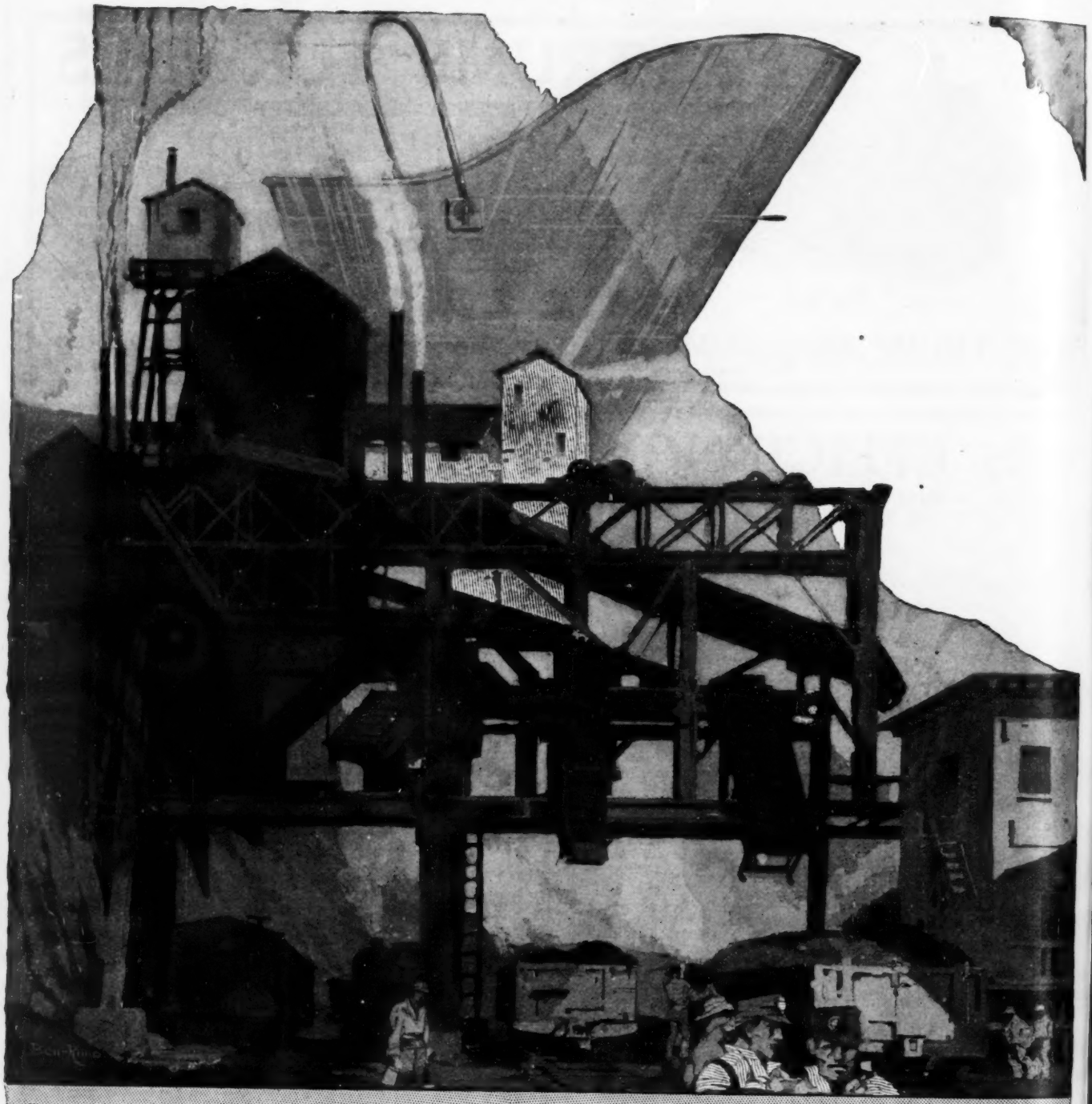

PUMPS–COMPRESSORS–CONDENSERS–OIL & GAS ENGINES–

WORTHINGTON

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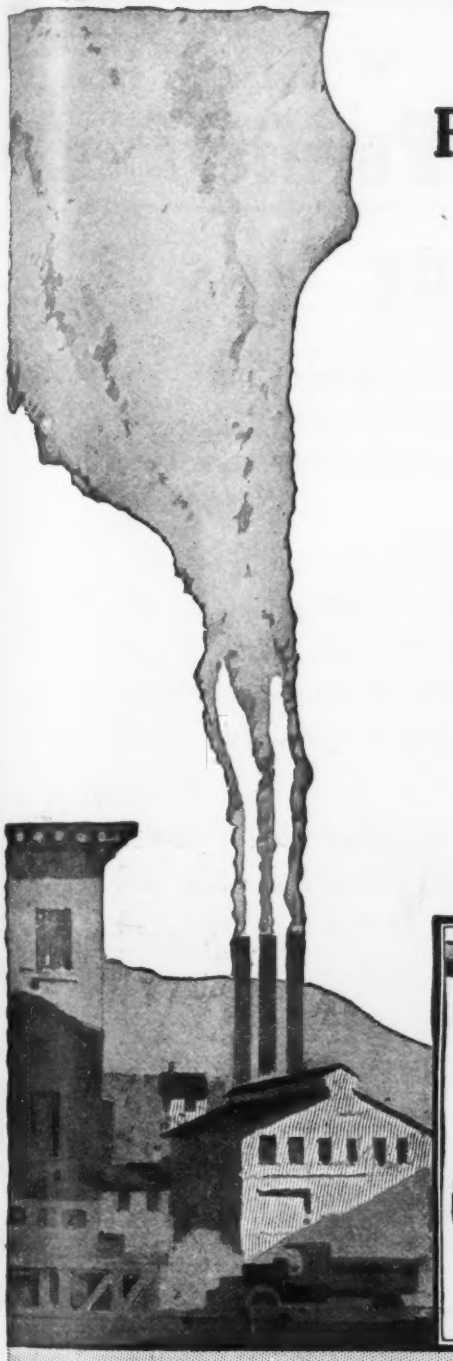

From High Vacuums to High Pressures

One reason Worthington Pumps are in every important mining center is because there is not a mine pumping service Worthington doesn't meet.

Air compressors, gathering pumps, centrifugal pumps, pumps of every kind and capacity for every condition of service.

And the way Worthington serves the Mining Industry is only typical of the way Worthington serves every industry.

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***Executive Offices:* 115 Broadway, New York City**
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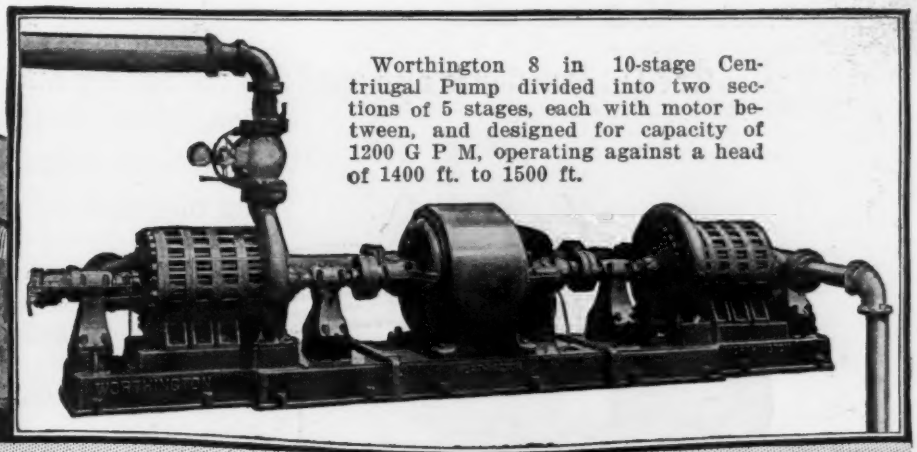

Worthington 8 in 10-stage Centriugal Pump divided into two sections of 5 stages, each with motor between, and designed for capacity of 1200 G P M, operating against a head of 1400 ft. to 1500 ft.

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The De Laval Oil Purifier is a new and modern means of purifying and reclaiming used lubricating oil which has become unfit and dangerous to use. The Method is simple, continuous and economical, and restores the oil to its original usefulness.

The Oil Purifier removes water, dirt, grit and metal particles from the oil, thereby maintaining clean oil in the oiling system. Hence the wearing parts last longer and a saving of the machinery is effected. The use of clean oil also reduces the loss of power to a minimum, eliminates the dangers of clogged oil systems and helps maintain the original factor of safety.

The De Laval Purifier is used in marine and stationary steam power plants; for Diesel and Semi-Diesel engine oils, and for crank case and motor block test oils.

The Oil Purifier is also used for reclaiming and purifying cutting oil from chips, cutting oil from soda-wash, hardening room drawing and quenching oils, fuel oils, etc.

De Laval Oil Purifier—Electric Driven

Write to nearest De Laval office for Oil Purification Bulletin No. 100; also Crank Case Oil Bulletin No. 102

A complete experimental department is maintained for working out the problems of our customers by means of centrifugal processes

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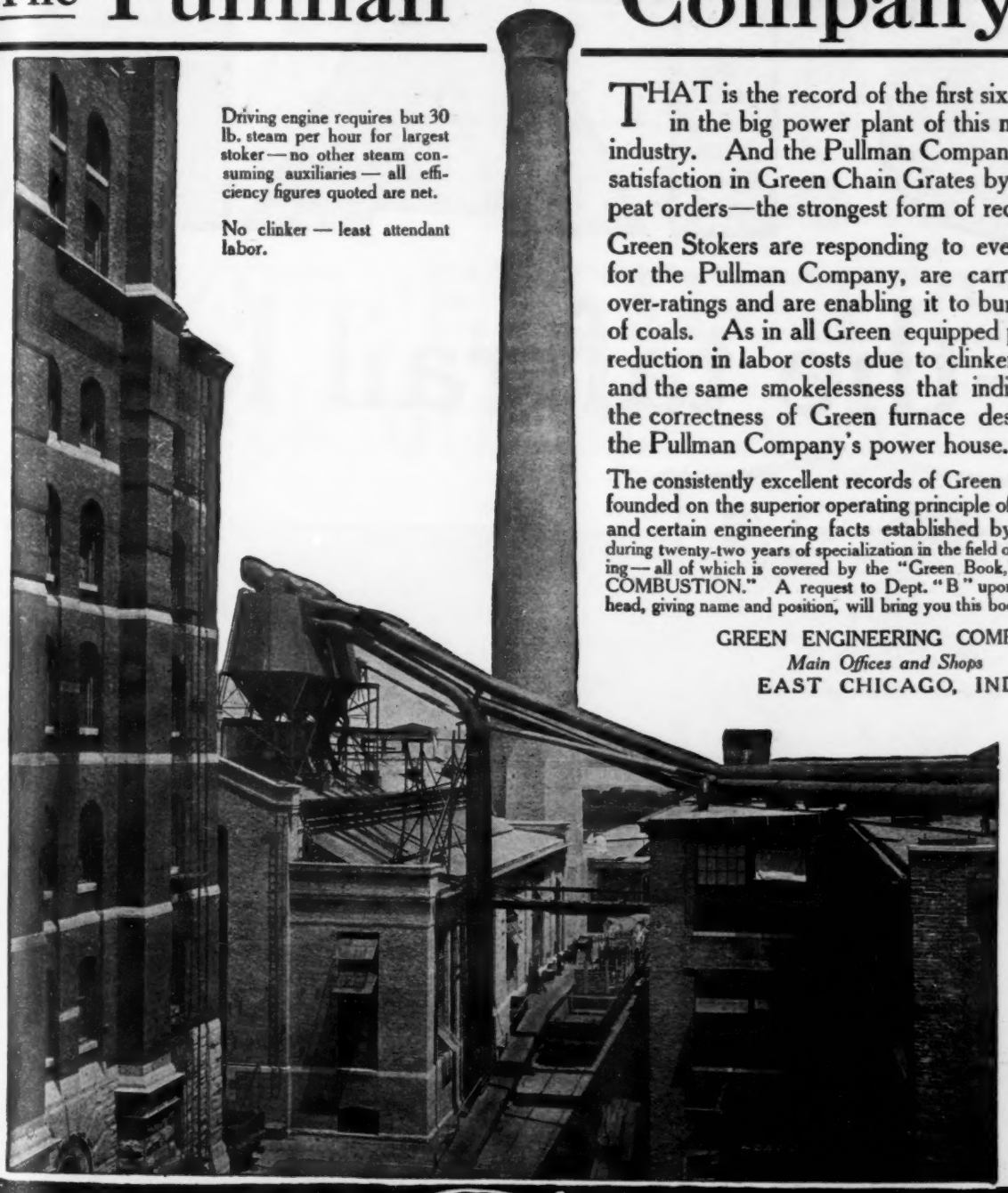

Driving engine requires but 30 lb. steam per hour for largest stoker — no other steam consuming auxiliaries — all efficiency figures quoted are net.

No clinker — least attendant labor.

THAT is the record of the first six stokers installed in the big power plant of this nationally known industry. And the Pullman Company has evidenced satisfaction in Green Chain Grates by placing two repeat orders—the strongest form of recommendation.

Green Stokers are responding to every load demand for the Pullman Company, are carrying continuous over-ratings and are enabling it to burn a wide range of coals. As in all Green equipped plants, the same reduction in labor costs due to clinker-free operation; and the same smokelessness that indisputably proves the correctness of Green furnace design, is found in the Pullman Company's power house.

The consistently excellent records of Green Chain Grates are founded on the superior operating principle of the Green Stoker and certain engineering facts established by Green engineers during twenty-two years of specialization in the field of combustion engineering — all of which is covered by the "Green Book," "PROGRESSIVE COMBUSTION." A request to Dept. "B" upon your company letter head, giving name and position, will bring you this book.

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Power Plant of the Pullman Company

Backed by 21 Years of Specialized Experience

GREEN sealflex Arches
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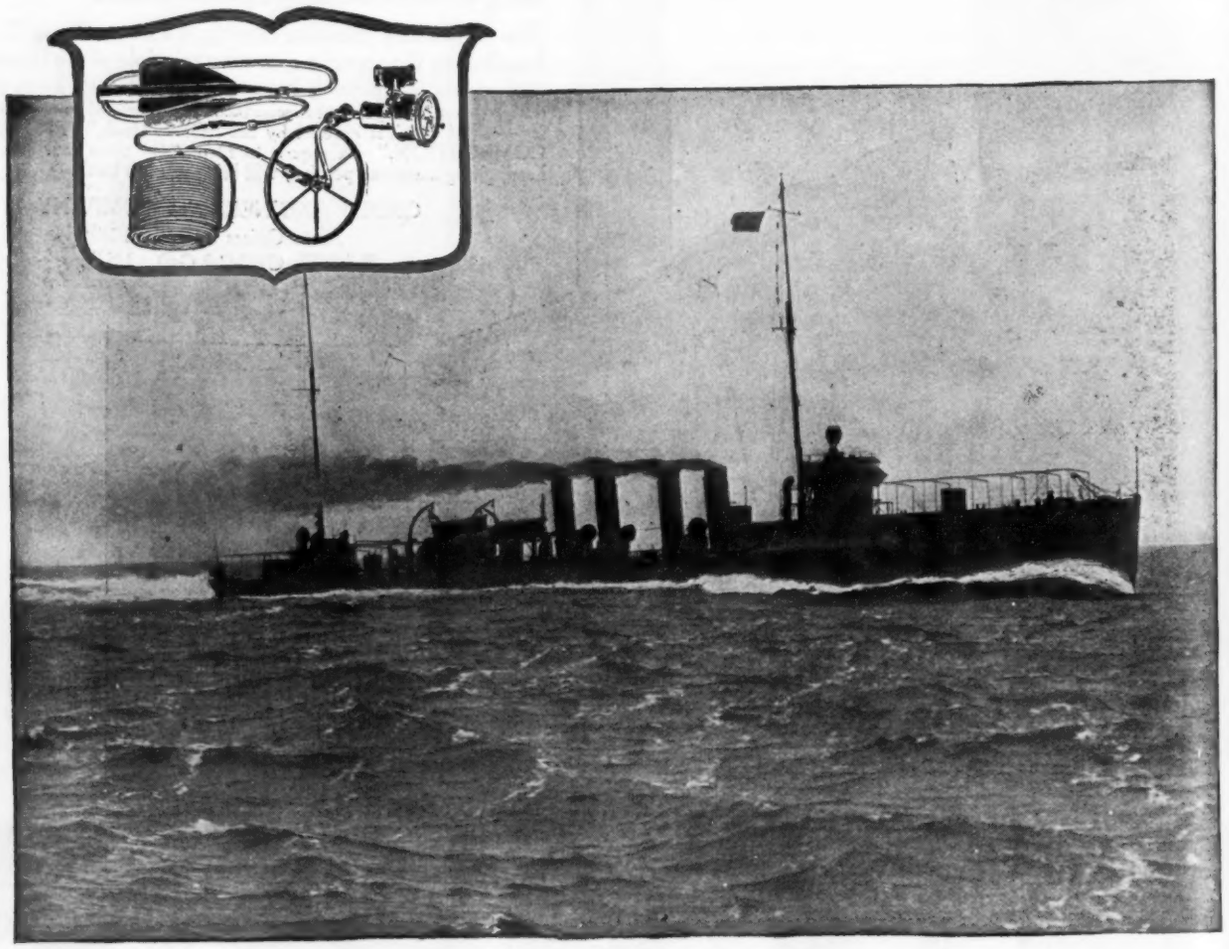
GREEN Materials Transfer and Storage Hopper

GREEN CHAIN GRATES

STAN

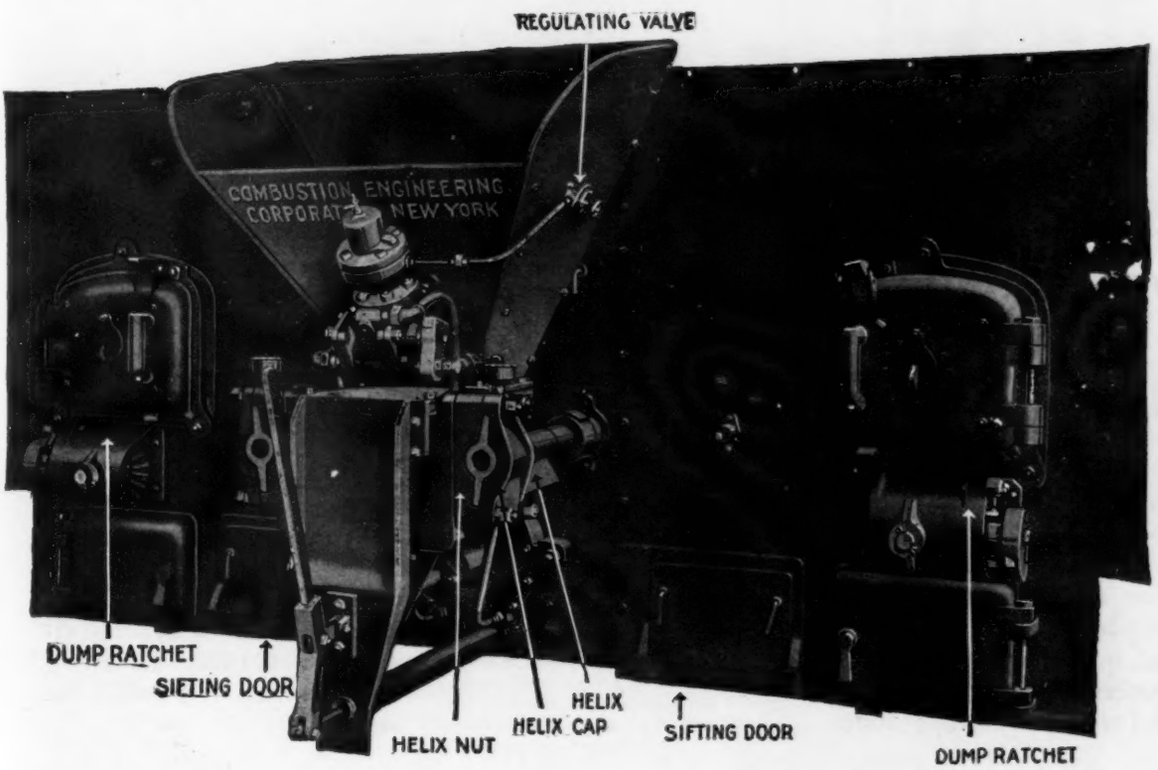
—the taffrail log



checks off the knots

DARD

TYPE "E" STOKERS
check off the wastes



Combustion Engineering Corporation
11 Broadway, New York City

Owners and Manufacturers of

Type "E" Stokers—for Bituminous Coal — The Grieve Grate—Hand-Firing
Coxe Stokers—Anthracite Coal and Coke Breeze

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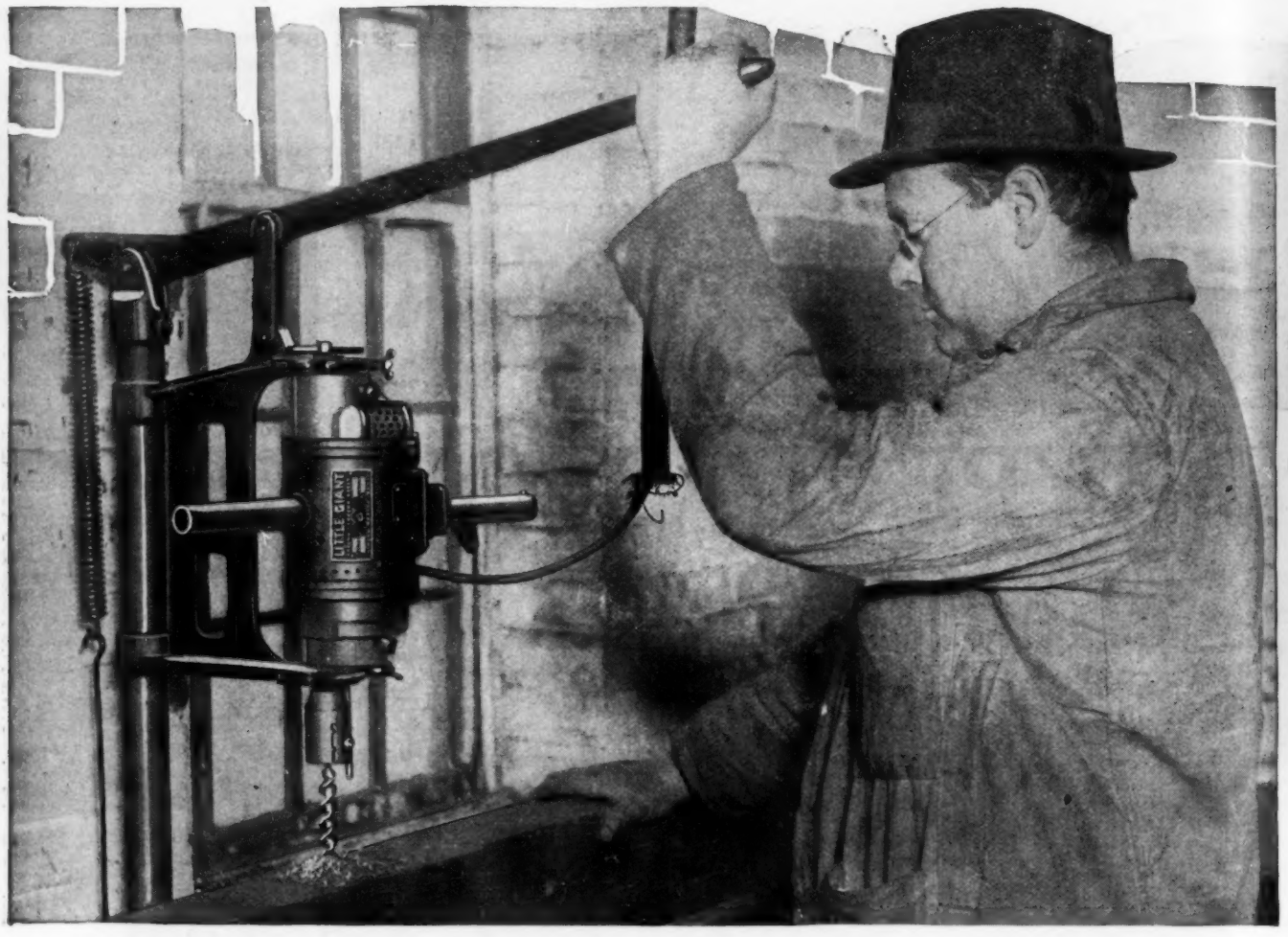
SALT LAKE CITY, UTAH TAYLOR ENGINEERING CO., VANCOUVER, B. C.



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LITTLE GIANT Portable Electric Drills may be quickly converted into an accurate sensitive Drill Press by clamping them into a Little Giant Drilling Stand. This simple, rugged device is proving of tremendous value in shops and factories everywhere, where it is at times desirable to provide a stationary drilling apparatus which may be as quickly reconverted into a portable tool for general drilling, reaming and wood boring operations about the plant. If you are already increasing your output with Little Giant Portable Electric Drills, enlarge their utility still further by adding Little Giant Drilling Stands to your equipment. If you have yet to enlist the unusual pulling power, low temperature rise, easy control, speed and economy of Little Giant Electric Drills in your service, install Little Giant Drilling Stands when you install the drills.

New uses for Little Giant Portable Electric Drills are being discovered daily. Wherever there is an electric socket they may be put quickly to work. Built in a variety of sizes A.C., D.C. and Universal Types. Write for Bulletins describing Portable Drills and Drilling Stands

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EL-14

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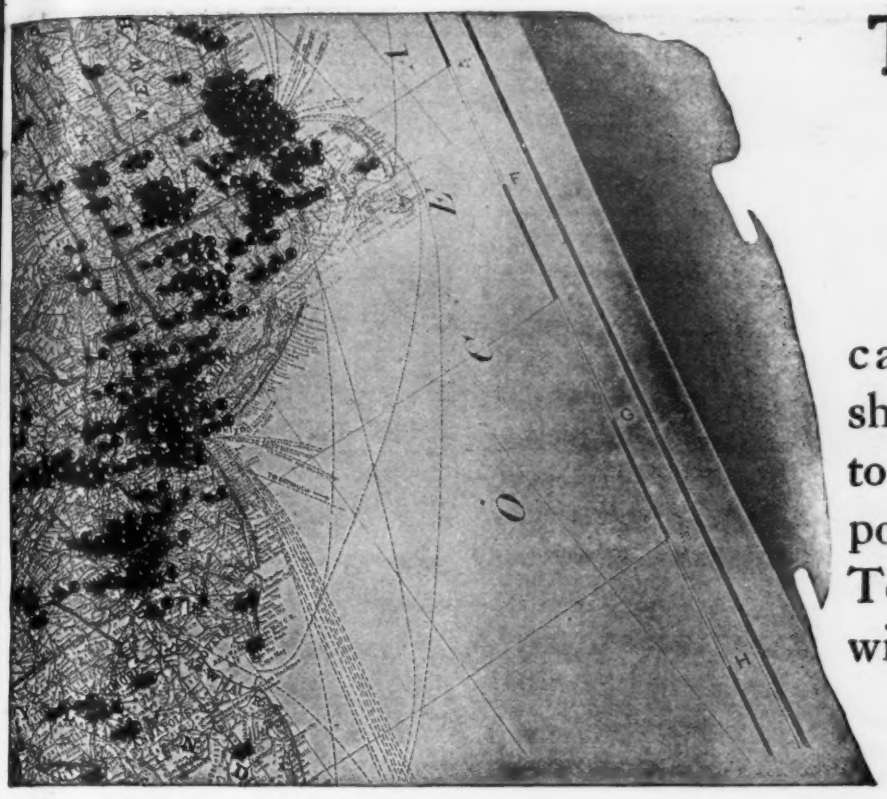
LITTLE *Electric* — CHICAGO PNEUMATIC — **GIANT** *Tools*



That Feeling of Security

called confidence should be the final factor in the selection of power plant equipment. To sign a contract without it would be to admit you were taking a chance.

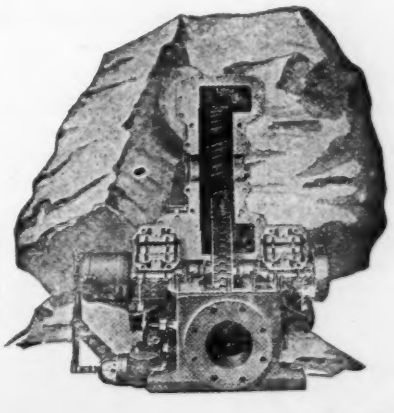
The pins in the map indicate towns or cities in which there are from one to two hundred Terrys each and, although this is a densely populated part of the country, less than one-tenth of all the Terrys are installed here. Yet, if the Terrys in Massachusetts alone were evenly spaced over the State, you couldn't get more than a mile away from one. Because of this vast number of Terry installations, it is obvious that a man who specifies

THE TERRY TURBINE

for Generator, Blower or Pumping units knows that he is not taking a chance. He is following the good judgment of thousands of engineers who know by experience what Terry service means. There is a sphinx-like stolidity behind equipment used so extensively which brings that feeling of security to the man who specifies.

Select your equipment with confidence.

Specify Terry



T-657

The Terry Steam Turbine Co.
Terry Square, Hartford, Conn.

Your Power Plant Accountant

Your Power Plant Accountant

offers you a daily balance sheet of your power plant efficiency.

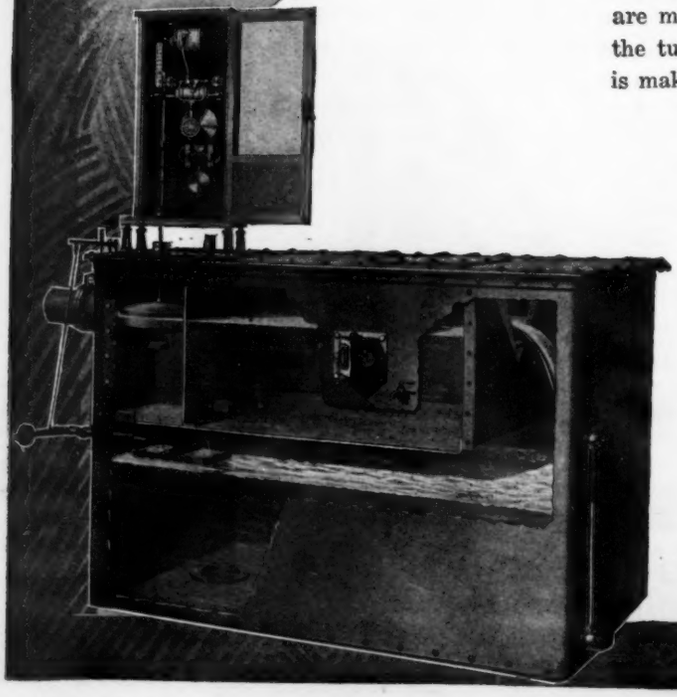
You no doubt know now from one or more tests, under the best conditions, how much H. P. your plant should develop, but do you know whether or not it is keeping up to that standard? Or if not, why not? Perhaps the coal is shy on B. T. U.; or maybe negligent firing methods are making black smoke and wasting fuel. Maybe soot is clogging the tubes, or scale is forming in the boilers, or worn out insulation is making wet steam—but whatever the trouble, a

YARWAY-LEA V-Notch METER

will record the drop in efficiency as fast as it develops, so that you can detect and stop the cause before the trouble becomes serious.

Or you can compare this week's output of power with last week's or with the same week of last year—provided you have a Yarway Lea Meter.

Write for more information—there is no obligation—and send a brief description of your plant so our engineers may give you the data that will fit your conditions.

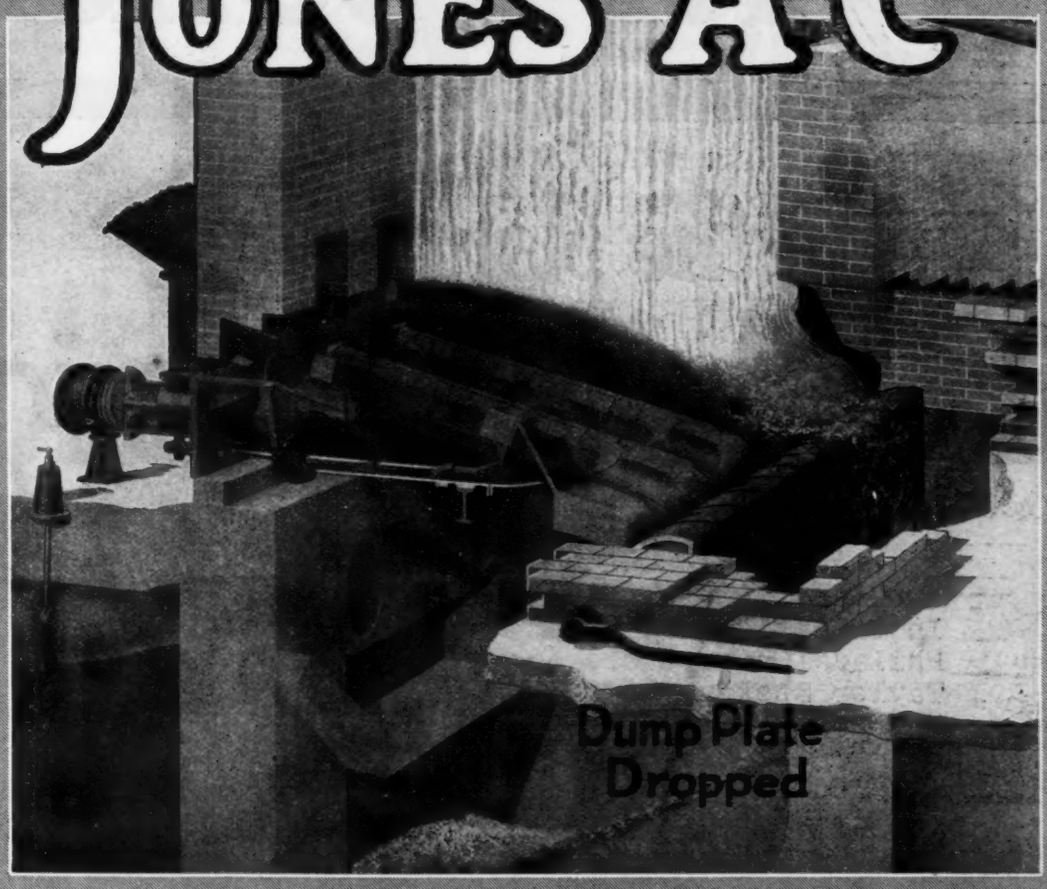


Yarnall Waring Company

7608-20 Queen St. - Chestnut Hill, Pa.

NEW YORK CHICAGO PITTSBURGH

JONES "A-C"



An Automatic-Cleaning Stoker That Saves Coal and Saves Labor

THIS high-duty Jones "A-C" Stoker saves coal and prevents smoke because it completely burns all the fuel—saves labor because it is self-cleaning—prevents clinkers by an intermittent movement of the fuel bed—has heavy overload capacity because of automatic control, with independent fuel and air adjustments—is extremely simple and low in maintenance cost—is arranged for individual control of retorts—develops very high efficiency on actual test. Write for complete new descriptive catalog.

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Makers of the JONES STOKER

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Pays for Itself—Then Pays Dividends

Taylor Stokers

in the plant of the

Philadelphia Electric Co

In this big station at Christian Street, Philadelphia, there are forty 7-retort Taylor Stokers under 500 to 600 H.P. Babcock & Wilcox boilers and twenty 10-retort Taylors under 1000 H.P. Babcock & Wilcox Boilers. Their record of installation speaks for itself. Nothing we could say could possibly add to the impressiveness of the long series of repeat orders. SERVICE COUNTS -- and service is what proves the superiority of Taylor Stokers. Write for our Booklets "Fuel Burning Reports."

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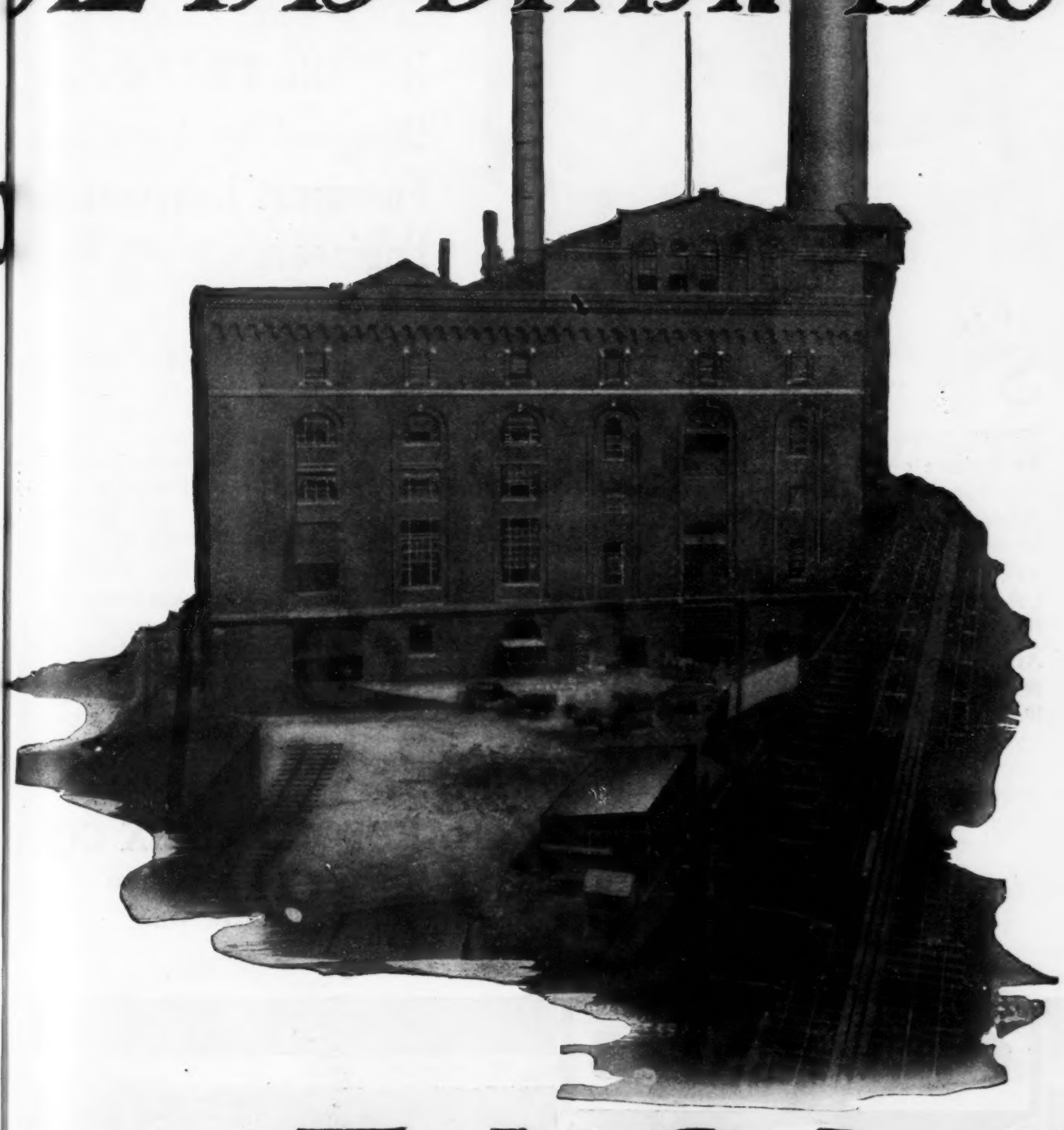
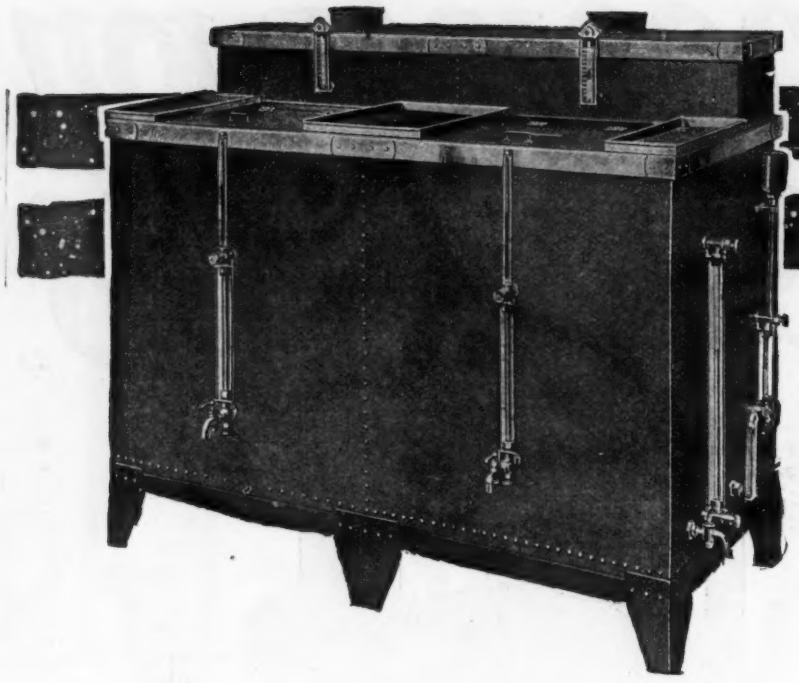
Babcock & Wilcox, Ltd., Oriel House, Farringdon Street, London, England

The TAYLOR System of Efficient Boiler Firing

Installed 1908-1909-1911 1912-1913-1914-1917-1918



The Taylor Stoker



R-P OIL FILTERS are Designed by America's Foremost Lubrication Engineers

SINCE the Richardson-Phenix Company was first formed, there has always been one dominant ideal in view—to become the best lubrication engineers in the world.

As evidence of the culmination of this ideal, Richardson-Phenix engineers are today recognized as **the** authority on the scientific application and purification of lubricants.

As the business has progressed, new engineers have been added to the organization—always the best men in this field that could be secured.

As a result there has never been a lubrication problem that R-P engineers have been called on to solve where they have not succeeded.

This is the one big reason why R-P Oil Filters have met with such success. The ultimate in engineering skill has gone into them. They represent the very maximum of simplicity and efficiency. An R-P Oil Filter is not only faultless in operation, but it will pay for itself in a very short time, besides insuring that your engines will always be lubricated by clean oil.

Bulletin L 10 fully describes the R-P Power Plant Oil Filter. It contains some mighty interesting engineering data and is well worth your investigation. Write for your copy. It is waiting.

THE RICHARDSON-PHENIX CO.

LUBRICATION ENGINEERS and MANUFACTURERS

127 Reservoir Ave., Milwaukee, Wis.

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OIL FILTERS

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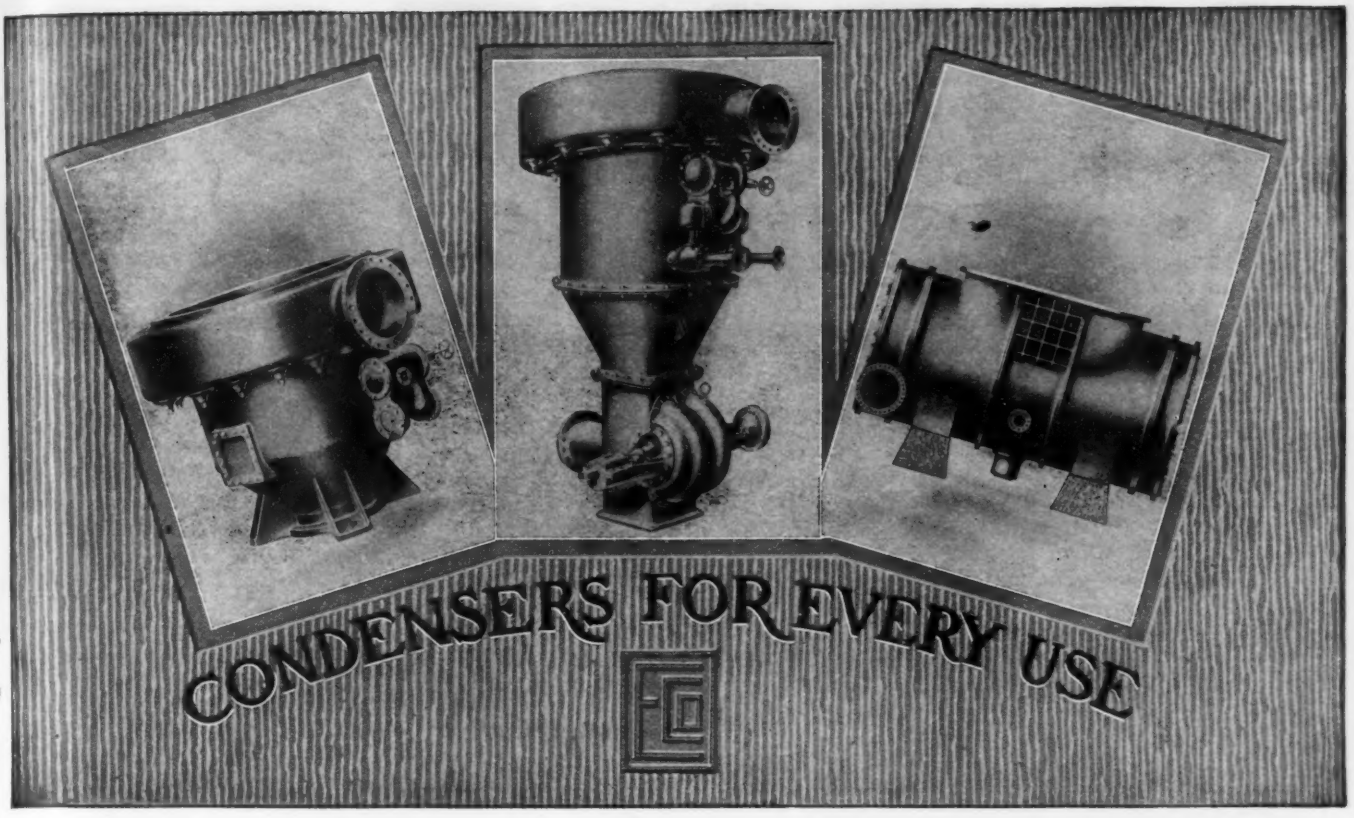
SCIENTIFIC LUBRICATION



We build all types of Condensers Jet -- Surface -- and Barometric

IN building a new plant—and before installing new and modern equipment in place of old fashioned or ill-suited equipment—first, be sure to get a broad-gauge conception of your plant peculiarities. In order to choose the equipment which exactly 'grooves' into those conditions.

Such an investment in forethought will save many dollars and much wasted time.

Then when you buy your equipment go to a concern which manufactures a piece of equipment suitable for adaptation to each of the several general sets of plant conditions.

If it is a condenser you want—have in mind that the Elliott Company designs and builds Condensors of all types.

In buying an Elliott Condenser you will not be urged to buy by a representative whose viewpoint is biased.

Instead, he will study your plant's peculiarities of location, etc., and then — and not until then — he will recommend the type which will prove the best investment to you.

Our Engineering Department is ready to advise you in this respect — whether you buy Elliott Condensers or not. Ask for Bulletin "C"

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ELLIOTT COMPANY

442 Fifth Avenue, Pittsburgh, Pa.

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This is a four-cylinder Midwest Clutch Type Diesel Oil Engine for Marine use—with many of the features that make Midwest Stationary Diesel Oil Engines so desirable.

The open crank-case makes it possible to remove pistons and piston rings without dismounting the cylinder heads or connecting rods.

The most economical operation possible is assured by this equipment, because it uses to the highest point of efficiency the very cheapest of low-priced crude and fuel oils.

Oil Engine Products

For Stationary Service—Midwest-Hvid Oil Engines, Horizontal, Four-Cycle, Standard and Special Electric: 20, 25, 30 and 35 B. H. P.

Midwest-Diesel Oil Engines, Vertical, Four-Cycle, Belted or Direct-Connected for General Power or Electrical Service: 50, 75, 100, 150, 190, 250 and 375 B.H.P.

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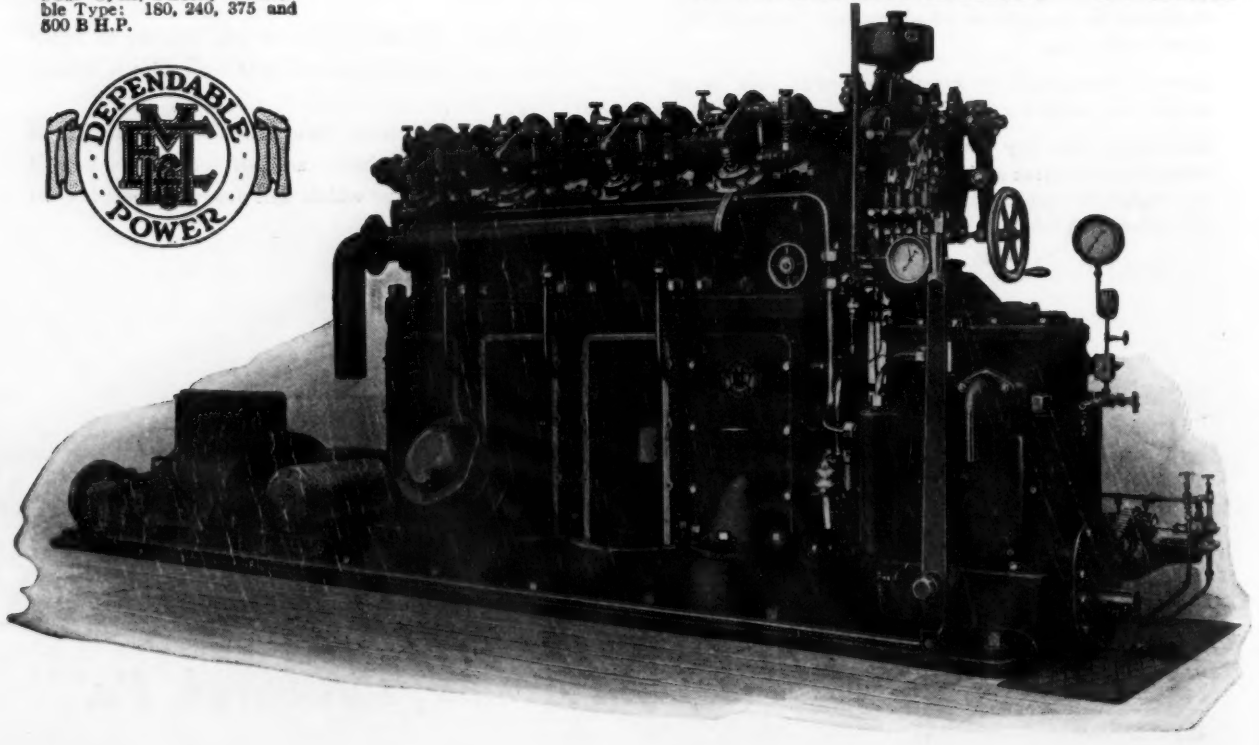
INDIANAPOLIS, U. S. A.

DEPENDABLE POWER



Moving a 3,000-ton Brick Building 450 feet - O

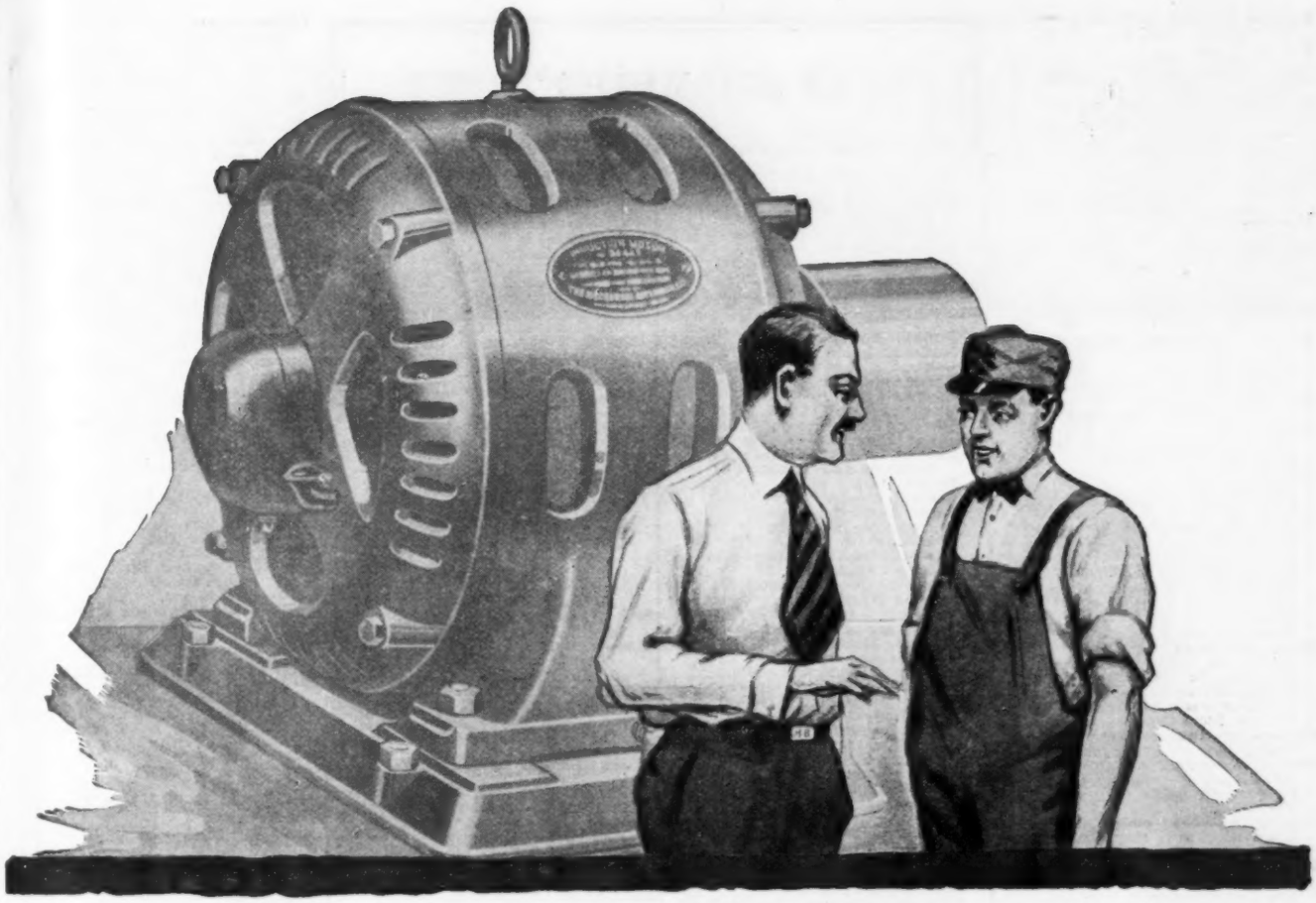
A Wagner-Quality Motor was used to move the 60′ x 95′ building of the Hyatt Roller Bearing Company from Cass and West Grand Boulevard to Cass and Milwaukee Avenues. According to the contractor, L. P. Friestedt Company of Chicago, this is the first time that electric motors have ever been used on such work. So smoothly was the operation carried out that office work inside the building proceeded without interruption. This is but another instance of how Wagner-Quality Motors so easily substantiate the judgment of their purchasers. You, too, can depend upon Wagner-Quality Motors whether they are used to move a building or drive machine tools—their service is always Wagner-Quality. Ask for Bulletins 1174 and 1184.

Wagner Electric Manufacturing Company,
Saint Louis, Missouri

WHAT AND WHERE TO BUY

Equipment, Apparatus and Supplies Advertised in this Issue with Names of Manufacturers and Distributors

Air Compressors
Allis-Chalmers Mfg. Co.
Fairbanks, Morse & Co.
General Electric Co.
Air Washers and Coolers
American Blower Co.
Spray Engrg. Co.
Aluminum
Aluminum Co. of America.
British Aluminum Co., Ltd.
Ammeters, Voltmeters
(See Instruments, Electrical).
Anchors, Guy
Hubbard & Co.
Matthews & Bro., Inc., W. N.
Ostrander & Co., W. B.
Anchors, Screw
Stine Screw Holes Co.
Arches, Boiler
Green Engineering Co.
Armature Discs and Segments
Bliss Co., E. W.
Armature Repair Machinery
Electric Service Supplies Co.
Asbestos Lumber
Johns-Manville Co., H. W.
White Co., The
Batteries, Dry Cell
Manhattan Elec'l Supply Co.
Western Elec. Co.
Batteries, Storage
Edison Storage Battery Co.
Electric Storage Battery Co.
Batteries, Storage Casings
International Nickel Co.
Battery Charging Apparatus
Cutler-Hammer Mfg. Co.
Electric Products Co.
General Elec. Co.
St. Louis Elec'l Wks.
Wesche Electric Co., B. A.
Westinghouse Elec. & Mfg. Co.
Bearings, Ball
Fafnir Bearing Co.
New Departure Mfg. Co.
Norma Co. of America.
Bearings, Thrust
Kingsbury, Albert
Belt Conveyors
Link-Belt Co.
Belting, Leather
Ladew Co., E. R.
Blowers, Electric
American Blower Co.
Sturtevant Co., B. F.
Blowers, Steam Driven
American Blower Co.
Green Fuel Economizer Co.
Terry Steam Turbine Co.
Boilers, Steam
Babcock & Wilcox Co.
Bigelow Co.
Edge Moor Iron Co.
Bolts, Expansion
Hubbard & Co.
Star Expansion Bolt Co.
Bolts and Nuts
Atlas Bolt and Screw Co.
Bond Testers
Roller-Smith Co.
Thompson Levering Co.
Books, Technical
McGraw-Hill Company, Inc.
Boosters
Crocker-Wheeler Co.
General Electric Co.
Ridgway Dynamo & Eng. Co.
Triumph Electric Co.
Westinghouse Elec. & Mfg. Co.
Wesche. Elec. Co., B. A.
Boxes, Fuse
General Electric Co.
Johns-Mannville Co., H. W.
Matthews & Bro., Inc., W. N.
Metropolitan Eng'g Co.
Westinghouse Elec & Mfg. Co.
Boxes, Junction and Outlet
Austin Co., The
Chicago Fuse Mfg. Co.
D. & W. Fuse Co.
General Electric Co.
National Metal Molding Co.
Pratt Chuck Co.
Sprague Electric Works
Westinghouse Elec & Mfg. Co.
Boxes, Meter and Service
General Elec. Co.
Johns-Manville Co., H. W.
Metropolitan Eng'g Co.
Brackets and Pins, Metal
Hubbard & Co.
Philadelphia Elec. & Mfg. Co.
Pittsburgh Transformer Co.
Brushes, Dynamo
Graphite Products Co.
Jeandron, W. J.
Morgan Crucible Co., Ltd.
National Carbon Co.
United States Graphite Co.
Buckets, Clamshell
Blaw-Knox Co.
Buckets, Excavating, Motor Driven
Blaw-Knox Co.
Hayward Co.
Link-Belt Co.
Buildings, Steel
Blaw-Knox Co.
Delta Star Elec. Co.
Milliken Bros. Mfg. Co.
Bus Bar Supports
Delta Star Electric Co.
Westinghouse Elec & Mfg. Co.
Bushings
Crouse-Hinds Co.
National Fibre & Insulation Co.
National Metal Molding Co.
Pratt Chuck Co.
Cable Accessories
Standard Underground Cable Co.
Cable Contractors
Sugden Co., James
Cable End Bells
Electrical Engineers Equipment Co.
Cable Racks
Hubbard & Co.
Metropolitan Eng'g Co.
Cabling Machinery
American Ins. Machinery Co.
New England Butt Co.
Carbon Brushes
Graphite Products Co.
Jeandron, W. J.
Morgan Crucible Co., Ltd.
National Carbon Co.
United States Graphite Co.
Cars, Coal & Ash Handling
Easton Car & Const. Co.
Castings
Triumph Electric Co.
Castings, Brass
Bridgeport Brass Co.
Nelson Valve Co.
Castings, Die
Acme Die Casting Corp.
Doehler Die-Casting Co.
Precision Castings Co.
Chains, Silent Driving
Morse Chain Co.
Chains, Silent Power Transmission
Link-Belt Co.
Morse Chain Co.
Circuit Breakers
Automatic Recl. Circ. Br. Co.
Condit Elec. Mfg. Co.
Electric Service Corp.
General Electric Co.
Industrial Controller Co.
Roller-Smith Co.
Sangamo Elec. Co.
Sundh Elec. Co.
Ward Leonard Elec. Co.
Westinghouse Elec. & Mfg. Co.
Clamps, Cable Supporting
Matthews & Bro., Inc., W. N.
Clamps, Ground Connections
Austin Co., M. B.
Condit Elec. Mfg. Co.
General Electric Co.
Clamps, Guy
Hubbard & Co.
Matthews & Bro., Inc., W. N.
Clamps, Insulator
Clark Elec. & Mfg. Co.
Electrical Engineers Equipment Co.
Cleats
Blake Signal & Mfg. Co.
Imperial Porcelain Works.
National Metal Molding Co.
Pass & Seymour, Inc.
Climbers, Linemen's
Buckingham, W. H.
Klein & Sons, Mathias.
Clips, Cable
Condit Elec. Mfg. Co.
Hubbard & Co.
Clusters
Benjamin Elec. Mfg. Co.
Federal Elec. Co.
Hubbell, Inc., Harvey
Clutches, Friction
Link-Belt Co.
Clutches, Magnetic
Cutler-Hammer Mfg. Co.
Coal
Bertha Coal Co.
Coal and Ash Handling Machinery
Blaw-Knox Co.
Green Engineering Co.
Hayward Co.
Link-Belt Co.
Northern Engineering Works
Pulverized Fuel Equipment Corp.
Coil Winding Tools
Electric Service Supplies Co.
Coils
Coto-Coil Co.
Dudlo Mfg. Co.
Coils, Armature, Field
D & W Fuse Co.
Independent Lamp & Wire Co.
Coils, Choke
Delta Star Elec. Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.
Commutator Stones
Pearl Commutator Dresser Co.
Commutators
Cameron Electric Mfg. Co.
Compounds, Commutator
McLennan Co., K.
Condensers
Elliott Company, The
Griscom-Russell Co.
Westinghouse Elec. & Mfg. Co.
Wheeler Condenser & Eng. Co.
Conduit Bends
Fibre Conduit Co.
Conduit Fittings
Austin Co., M. B.
Fibre Conduit Co.
Pass & Seymour, Inc.
Pratt Chuck Co.
Sprague Electric Works
Conduits, Interior
American Circular Loom Co.
Austin Co., The
National Metal Molding Co.
Sprague Electric Works
Tubular Woven Fabric Co.
Youngstown Sheet & Tube Co.
Conduits, Underground (Fibre)
Fibre Conduit Co.
Johns-Manville Co., H. W.
National Fireproofing Co.
Connectors, Solderless
Walger Connector Co.
Westinghouse Elec. & Mfg. Co.
Connectors and Terminals
Electrical Engineers Equipment Co.
Walger Connector Co.
Westinghouse Elec. & Mfg. Co.
Contact Rail Material
Electric Service Supplies Co.
Controllers, Motor
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.
General Electric Co.
Industrial Controller Co.
Monitor Controller Co.
Sundh Electric Co.
Ward Leonard Elec. Co.
Westinghouse Elec. & Mfg. Co.
Conveying Machinery
(Coal, Ashes, Etc.)
American Bridge Co.
Green Engineering Co.
Cooling Ponds, Spray
Spray Engrg. Co.
Cord Adjusters
American Vul. Fibre Co.
National Fibre & Insulation Co.
Cord, Arc Lamp
Samson Cordage Works.
Cord, Flexible
Belden Mfg. Co.
Lowell Insulated Wire Co.
Rome Wire Co.
Cord, Trolley
Samson Cordage Works.
Couplings, Flexible
Smith and Serrell
Couplings, Rigid Shaft
Smith and Serrell
Cranes, Locomotive
Link-Belt Co.
Crane Motors
Sprague Electric Works
Triumph Electric Co.
Westinghouse Elec. & Mfg. Co.
Cranes, Traveling
American Bridge Co.
Maris Bros.
Cross Arms
American Bridge Co.
Hubbard & Co.
Philadelphia Elec. & Mfg. Co.
Western Electric Co.
Crushers, Coal and Coke
Link-Belt Co.
Cutouts
Arrow Electric Co.
Condit Elec. Mfg. Co.
D & W Fuse Co.
General Elec. Co.
Matthews & Bro., Inc., W. N.
Metropolitan Eng'g Co.
Devices, Protective
Clark Electric & Mfg. Co.
Dies, Cutting
Bliss Co., E. W.
Draft, Mechanical
Green Fuel Economizer Co.
Sturtevant Co., B. F.
Drills, Brick
Hubbard & Co.
Dynamos and Motors
Allis-Chalmers Mfg. Co.
Burke Elec. Co.
Century Electric Co.
Colonial Fan & Motor Co.
Crocker-Wheeler Co.
Diehl Mfg. Co.
Electric Machinery Co.
Electro-Dynamic Co.
Emerson Electric Mfg. Co.
Fairbanks, Morse & Co.
General Electric Co.
Gregory Electric Co
Holtzer-Cabot Electric Co.
Howell Elec. Motors Co.
Kimble Electric Co.
Mechanical Appliance Co.
Northwestern Electric Co.
Peerless Electric Co.
Reliance Elec. & Eng'g. Co.
Ridgway Dynamo & Engine Co.
Robbins & Myers Co.
Roth Bros. & Co.
Sprague Electric Works
Sturtevant Co., B. F.
Triumph Electric Co.
Wagner Electric Mfg. Co.
Wesche Electric Co., B. A.
Western Elec. Co.
Westinghouse Elec. & Mfg. Co.
Ebony Asbestos Wood (Switchboard Material)
Johns-Manville Co., H. W.
Economizers, Fuel
Green Fuel Economizer Co.
Sturtevant Co., B. F.
Electromagnets
Acme Wire Co.
Coto-Coil Co.
Elec. Controller & Mfg. Co.
Ohio Elec. & Controller Co.
Ward Leonard Elec. Co.
Engineers, Consulting and Contracting
(See also Directory of Engineers)
Engines, Gas and Gasoline
Allis-Chalmers Mfg. Co.
Fairbanks, Morse & Co.
Engines, Oil
Busch-Sulzer Bros.—Diesel & Co.
Midwest Engine Co.
Chicago Pneumatic Tool Co.
De La Vergne Machine Co.
Fairbanks, Morse & Co.
McIntosh & Seymour Corp.
Nordberg Mfg. Co.
Engines, Steam
Allis-Chalmers Mfg. Co.
American Blower Co.
Ridgway Dynamo & Eng. Co.
Evaporators, Water
Griscom-Russell Co.
Excavating Machinery, Motor Driven
Hayward Co.
Experimental Apparatus
Biddle, James G.
Leeds & Northrup Co.
Roller-Smith Co.
Fan Motors
Adams, Bagnall Elec. Co.
Century Elec. Co.
Colonial Fan & Motor Co.
Diehl Mfg. Co.
Emerson Electric Mfg. Co.
General Elec. Co.
Gilbert Co., A. C.
Peerless Electric Co.
Robbins & Myers Co.
Sprague Electric Works
Western Elec. Co.
Westinghouse Elec. & Mfg. Co.
Wilmington Fibre Spec. Co.
Fans (Exhaust and Ventilating)
Adams, Bagnall Elec. Co.
American Blower Co.
Crocker-Wheeler Co.
Diehl Mfg. Co.
Emerson Elec. Co.
Fairbanks, Morse & Co.
General Elec. Co.
Green Fuel Economizer Co.
Kimble Elec. Co.
Mechanical Appliance Co.
Robbins & Myers Co.
Sprague Electric Works
Sturtevant Co., B. F.
Westinghouse Elec. & Mfg. Co.
Fans, Turbine Driven
Terry Steam Turbine Co.
Fault Finders, Cable
Elliott Co.
Matthews & Bro., Inc., W. N.
Feed Water Heaters
Elliott Company, The
Griscom-Russell Co.
Fibre
American Vul. Fibre Co.
Diamond State Fibre Co.
Fibre Conduit Co.
National Fibre & Insulation Co.
Filters, Oil
Elliott Company, The
Hunt Mfg. Co., E. J.
Richardsor-Phenix Co
Filters, Water
Elliott Company, The
Griscom-Russell Co.
Scaife & Sons, W. B.
Financial
Coal & Iron National Bank.
Fire Extinguishers
Johns-Manville Co., H. W.
Fire Extinguishers, Liquid For
Castle, Inc., James M.
Watkins, Fred A.



"We Can't Afford to Forget Watson Service"

THAT'S the way the factory superintendent feels when its necessary to install additional motors. If his factory is using Watson Motors he knows that Watson Service is a real asset. Whenever he thinks of Watson Motors he thinks of the organization behind them. To him Watson Motors and Watson Service are inseparable.

Watson Service fits the ***right*** Watson Motor into the job you want it to fill. It furnishes you power without waste, exactly the type and size of motor for your special work. And personal, whole-hearted co-operation ***follows*** the sale, insuring the proper operation of every Watson Motor you install.

Watson high-grade Motors have been favorably known for 17 years—and Watson Service is on a par with the product, a satisfying combination.

THE MECHANICAL APPLIANCE CO., Milwaukee, Wis

Chicago, Detroit, New York, Boston, Cleveland, Minneapolis, Cincinnati, Pittsburgh, Philadelphia, Toronto

"Every Watson Salesman is an Engineer"

WATSON ELECTRIC MOTORS

WHAT AND WHERE TO BUY

Fixture Holders, Adjustable
Matthews & Bro., Inc., W. N.
Fixture Studs
Pratt Chuck Co.
Fixtures, Adjustable Lighting
American Fixture Co.
Fixtures, Electric and Gas
Adams-Bagnall Elec. Co.
American Fixture Co.
Benjamin Elec. Mfg. Co.
Federal Elec. Co.
Fixtures, Street Lighting
Campbell Electric Co.
Philadelphia Elec. & Mfg. Co.
Flashers
Campbell Electric Co.
Flooring, Grating
Irving Iron Works Co.
Flooring, Metallic
Irving Iron Works Co.
Friction Tape and Cloths
Johns-Manville Co., H. W.
Furnace Equipment, Water Cooled
Blaw-Knox Co.
Furnaces, Electric
Detroit Electric Furnace Co.
Furnaces, Pulverized Coal
Pulverized Fuel Equipment Corp.
Fuse Plugs
Arrow Electric Co.
Delta Star Electric Co.
Fuses
Bussman Mfg. Co.
Condit Elec. Mfg. Co.
D. & W. Fuse Co.
Delta Star Elec. Co.
Economy Fuse & Mfg. Co.
General Electric Co.
Johns-Mannville Co., H. W.
Metropolitan Eng'g Co.
Schweitzer & Conrad, Inc.
Western Elec. Co.
Westinghouse Elec & Mfg. Co.
Fuses, Refillable
Austin Co., The
Bussman Mfg. Co.
Chicago Fuse Mfg. Co.
Economy Fuse & Mfg. Co.
Federal Elec. Co.
Galvanizing, Custom Work
Cattie, Jos. P. and Bros.
Gauges, Recording
Bristol Co.
Foxboro Co., The,
Yarnall-Waring Co.
Gearing, Silent Flexible
Clark Electric & Mfg. Co.
Morse Chain Co.
Gears
General Elec. Co.
Gears, Herringbone
Poole Eng'g & Mach. Co.
Gears, Reduction
Poole Eng'g. & Mach. Co.
Generating Sets
Automatic Light Co.
Westinghouse Elec. & Mfg. Co.
Generating Sets, Engine and Turbine
Sturtevant Co., B. F.
Universal Motor Co.
Globes, Shades, etc.
Adams Bagnall Elec. Co.
Ivanhoe-Regent Works
Gratings
Irving Iron Wks. Co.
Grating, Flooring
Irving Iron Wks. Co.
Grease Extractors
Elliott Company, The
Grounds, Etc.
Paragon Electric Co.
Guards, Incandescent Lamp
Hubbell, Inc., Harvey
Matthews & Bro., Inc., W. N.
Hack Saws, Rotary
Barnes & Irving, Inc.
Hair Driers
Shelton Elec. Co.
Hangers, Cable
Condit Elec. Mfg. Co.
Hubbard & Co.
Hangers, Catenary
International Nickel Co.
Head Gates
American Bridge Co.
Heating Devices, Electric
General Electric Co.
Western Elec. Co.
Westinghouse Elec. & Mfg. Co.
Heating and Ventilating Systems
Sturtevant Co., B. F.
Hoists, Air
Curtis Pneumatic Machy. Co.
Hoists, Electrical and Steam
Allis-Chalmers Mfg. Co.
Fairbanks, Morse & Co.
Link-Belt Co.
Sprague Electric Works
Ice Machines
Kelvinator Corp.
Indicators, Sight Flow
Richardson-Phenix Co.
Indicators, Speed
Biddle, James G.
Roller-Smith Co.
Thompson Levering Co.
Industrial Railways and Cars
Easton Car & Const. Co.
Instrument Transformers
General Elec. Co.
Westinghouse Elec. & Mfg. Co.
Weston Electrical Instrument Co.
Instruments, Electrical Graphic.
Biddle, James G.
Bristol, Co.
General Electric Co.
Sangamo Elec. Co.
Thompson Levering Co.
Westinghouse Elec. & Mfg. Co.
Weston Elec Instrument Co.
Indicating
General Electric Co.
Roller-Smith Co.
Wagner Elec. Mfg. Co.
Westinghouse Elec. & Mfg. Co.
Weston Electrical Instrument Co.
Integrating
Biddle, James G.
Duncan Elec. Mfg. Co.
National Lamp Works
General Electric Co.
Roller-Smith Co.
Sangamo Electric Co.
Westinghouse Elec. & Mfg. Co.
Weston Elec. Instrument Co.
Repairing and Testing
Illinois Testing Laboratories
Scientific and Testing.
Biddle, James G.
General Electric Co.
Leeds & Northrup Co.
Metropolitan Eng'g Co.
Westinghouse Elec. & Mfg. Co.
Weston Elec. Instrument Co.
Insulating Cement
Condensite Co. of America
Insulating Machinery
American Ins. Machinery Co.
New England Butt Co.
Insulating Material
China and Porcelain
Habirshaw Elec. Cable Co.
Imperial Porcelain Works.
Jeffery-Dewitt Co.
Lapp Insulator Co., Inc.
Locke Insulator Mfg. Co.
Ohio Brass Co.
Pittsburg H. V. Ins. Co.
Texas Company
Compounds, Paints and Varnishes
Barrett Co., The
Condensite Co. of America
Formica Insulation Co.
Garfield Mfg. Co.
Habirshaw Elec. Cable Co.
Mitchell-Rand Mfg. Co.
Redmanol Chemical Products Co.
Standard Paint Co.
Westinghouse Elec. & Mfg. Co.
Compounds, Cloth and Paper
Hope Webbing Co.
Westinghouse Elec. & Mfg. Co.
Fibre
Amer. Vulcanized Fibre Co.
Lava
American Lava Co.
Steward Mfg. Co., D. M.
Mica
Munsell & Co., Eugene
Silk
Ryle & Co., Wm.
Slate
Mitchell-Rand Mfg. Co.
New York Insulated Wire Co.
Okonite Co., The
Structural Slate Co.
Tape
Diamond State Fibre Co.
Johns-Mannville Co., H. W.
National Fibre & Insulation Co.
Hope Webbing Co.
Structural Slate Co.
Westinghouse Elec. & Mfg. Co.
Insulating Paper.
Barrett Co., The
Diamond State Fibre Co.
National Fibre & Insulation Co.
Insulator Pins
Hubbard & Co.
Insulators
China, Porcelain and Composition
Imperial Porcelain Works.
Jeffery-Dewitt Co.
Lapp Insulator Co., Inc.
Locke Insulator Mfg. Co.
Ohio Brass Co.
Peru Electric Co.
Pittsburg High Volt Ins. Co.
Westinghouse Elec. & Mfg. Co.
Glass
Brookfield Glass Co.
Lapp Insulator Co., Inc.
Locke Insulator Mfg. Co.
Insulators
Delta Star Electric Co.
Insulators, Glass
Hemingray Glass Co.
Lamp Guards
Flexible Steel Lacing Co.
Hubbell, Inc., Harvey
Matthews & Bros., Inc., W. N.
Lamp Locks
Pass & Seymour
Lamp Replacers
G. C. A. Mfg. Co.
Matthews & Bro., Inc., W. N.
Lamps, Arc
Adams, Bagnall Elec. Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.
Lamps, Flaming Arc
General Electric Co.
Westinghouse Elec. & Mfg. Co.
Lamps, Incandescent
Boston Economy Lamp Div.
Br. Thomson-Houston Co., Ltd.
Chicago Elec. Lamp Co.
Consolidated Elec. Lamp Co.
General Electric Co.
Hygrade Lamp Co.
Independent Lamp & Wire Co.
Western Elec. Co.
Westinghouse Lamp Co.
Whitelite Elec. Co.
Lamps, Miniature
General Electric Co.
Miniature Incandescent Lamp Corpn.
Lathes
Goodell-Pratt Co.
Lighting Plants, Isolated Type
Automatic Light Co.
Lighting Fixtures, Industrial
Benjamin Elec. Mfg. Co.
Philadelphia Elec. & Mfg. Co.
Lightning Arresters
Delta Star Elec. Co.
Electric Service Supplies Co.
Electrical Engineers Equipment Co.
General Electric Co.
Hubbard & Co.
Lewis & Roth Corp.
Schweitzer & Conrad, Inc.
Westinghouse Elec. & Mfg. Co.
Line Material
Anderson Mfg. Co., A. & J. M.
Archbold-Brady Co.
Clark Elec. & Mfg. Co.
Link-Belt Co.
Electric Service Supplies Co.
General Electric Co.
Hubbard & Co.
Johns-Mannville Co., H. W.
Ohio Brass Co.
Philadelphia Elec. & Mfg. Co.
Western Elec. Co.
Westinghouse Elec. & Mfg. Co.
Linemen's Shields
Matthews & Bro., Inc., W. N.
Lubricating, Oils
Borne Scrymser Co.
Lubrication Engineers
Richardson-Phenix Co.
Lubricators
Richardson-Phenix Co.
Machine Screws
Atlas Bolt & Screw Co.
Machinery, Conveyor
Link-Belt Co.
Machines, Armature Notching
Ferracute Machine Co.
Machines, Wire Tapping
Bush Electric Co.
Magnanin
Baker & Co., Inc.
Magnet Wire
Acme Wire Co.
American Brass Co.
American Electrical Works
American Steel & Wire Co.
Ansonia Elec. Co.
Belden Mfg. Co.
D & W Fuse Co.
Hazard Mfg. Co.
Independent Lamp & Wire Co.
Massachusetts Elec. Mfg. Co.
Roebling's Sons Co., J. A.
Rome Wire Co.
Western Elec. Co.
Magnets
Acme Wire Co.
Coto-Coil Co.
Cutler-Hammer Mfg. Co.
Dudlo Mfg. Co.
Magnets, Lifting
Cutler-Hammer Mfg. Co.
Elec. Controller & Mfg. Co.
Ohio Elec. & Controller Co.
Marine Lighting and Signaling App.
Benjamin Electric Mfg. Co.
Mechanical Stokers
Amer. Engrg. Co.
Combustion Engineering Corp.
Riley Stoker Co., Ltd., Sanford.
Underfeed Stoker Co.
Westinghouse Elec. & Mfg. Co.
Metal Work, Drawn and Stamped
Patten-MacGuyer Co.
Risdon Tool & Mach. Co.
Meter Testers
States Company, The
Westinghouse Elec. & Mfg. Co.
Meters, Electric (See Instruments)
Meters, Flow
General Elec. Co.
Spray Engineering Co.
Mica
Ford Mica Co.
Munsell & Co., Eugene
Mining Machinery
Allis-Chalmers Mfg. Co.
Fairbanks, Morse & Co.
Molded Insulation
Condensite Co. of America
Formica Insulation Co.
Garfield Mfg. Co.
Johns-Manville Co., H. W.
Northern Industrial Chemical Co.
Redmanol Chemical Products Co.
Molded Parts
Belden Mfg. Co.
Condensite Co. of America
Molding, Metal
National Metal Molding Co.
Monel Metal
International Nickel Co.
Motors.
(See Dynamos & Motors.)
Nickel and Alloys
International Nickel Co.
Nozzles, Spray.
Spray Engineering Co.
Oils, Lubricating
Borne Scrymser Co.
Texas Company
Oils, Transformer
Borne Scrymser Co.
Texas Company
Oilers, Telescope
Richardson-Phenix Co.
Oiling Systems, Cutting
Richardson-Phenix Co.
Oiling Systems, Hydro-electric.
Richardson-Phenix Co.
Oiling Systems, Sight Feed
Richardson-Phenix Co.
Oiling Systems, Steam Turbine
Richardson-Phenix Co.
Oiling Systems, Turbine
Richardson-Phenix Co.
Packing
Johns-Manville Co., H. W.
Leeds & Northrup Co.
Paints, Preservative
Barrett Co., The
Panel Boards.
Adams Bagnall Elec. Co.
Benjamin Electric Mfg. Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.
Panels, Switchboard
General Electric Co.
Packard Elec. Co.
Westinghouse Elec. & Mfg. Co.
Penstocks
Blaw-Knox Co.
Photometric Apparatus
Elec'l Testing Laboratories.
Leeds & Northrup Co.
Pipe Fittings
Richardson-Phenix Co.
Pipe, Wood
Continental Pipe Mfg. Co.
Plate Work
Blaw-Knox Co.
Platinum
Baker & Co., Inc.
Plugs, Attachment
Arrow Electric Co.
Benjamin Electric Mfg. Co.
Condit Elec. Mfg. Co.
Cutler-Hammer Mfg. Co.
General Electric Co.
Hubbell, Inc., Harvey.
National Metal Molding Co.
Pole Erectors
American Bridge Co.
Matthews & Bro., Inc., W. N.
Pole Line Hardware
Hubbard & Co.
Western Elec. Co.
Page & Hill Co.
Poles, Brackets and Pins
Western Elec. Co.
Poles, Cedar
Northern White Cedar Assn.
Poles, Reinforcing
Hubbard & Co.
Poles, Steel.
Archbold-Brady Co.
Bates Exp. Steel Truss Co.
Blaw-Knox Co.
Milliken Bros.
Poles, Ties (Wood)
Carney & Co., B. J.
Valentine-Clark Co.
Porcelain. (See Insulating Material, China and Porcelain)
Potentiometers.
Biddle, James G.
General Electric Co.
Potheads.
Okonite Co., The.
Preservatives, Wood
Barrett Co., The
The Northeastern Co.
Presses, Cutting
Bliss Co., E. W.
Ferracute Machine Co.
Projectors, Floodlighting
Electric Service Supplies Co.
Watkins, Fred A.
Protective Devices
Benjamin Electric Mfg. Co.
Clark Elec. & Mfg. Co.
Condit Elec. Mfg. Co.
General Electric Co.
Metropolitan Engineering Co.
Schweitzer & Conrad, Inc.
Westinghouse Elec. & Mfg. Co.
Pulleys, Steel
Dodge Sales and Eng. Co.
Pulleys, Wood
Dodge Sales and Eng. Co.
Pulverized Fuel Equipment
Pulverized Fuel Equipment Corp
Pumps, Air.
Fairbanks, Morse & Co.
Wheeler Condenser & Eng. Co.
Pumps, Centrifugal
Allis-Chalmers Mfg. Co.
Fairbanks, Morse & Co.
Manistee Iron Works
Midwest Engine Co.
Pelton Water Wheel Co.
Terry Steam Turbine Co.

CROCKER-WHEELER MOTORS

"Niagara's Rival for Dependable Power"

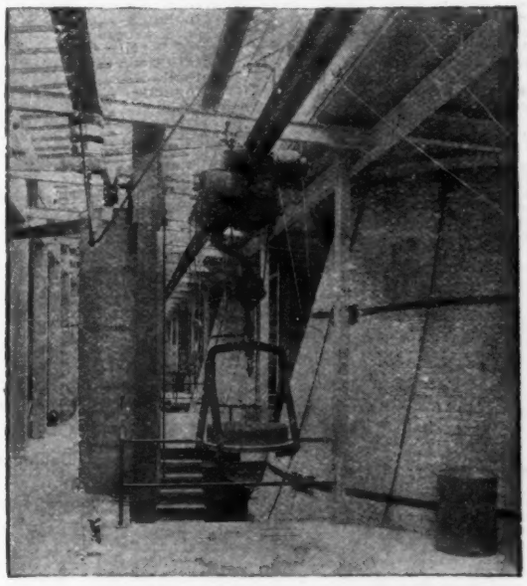
C-W Quality Is a Principle

Rules pass away with the things to which they refer. But principles are *permanent.* There are no rules, as such, governing the quality of C-W production. Crocker-Wheeler quality is a *principle.*

Crocker-Wheeler Form L Motor is an admirable example of the hard and fast principles of engineering that have marked the Company's substantial progress. The photograph below shows a floor controlled electric hoist driven by C-W Form L Motor.

Many industries are thoroughly aware of the value of a small overhead hoist. This may be suspended by a hook or mounted on an I beam used for the lifting of weights at one point or for lifting and transporting loads.

Good Hoists use C-W Motors to drive them



Floor Controlled Electric Hoist; Driven by Crocker-Wheeler Form L Motor; Installed with Norton Grinding Co., Worcester, Mass.; Crocker-Wheeler Company, Ampere, N. J.; Send for Bulletin 1741 describing it.

Plant and Laboratories of the

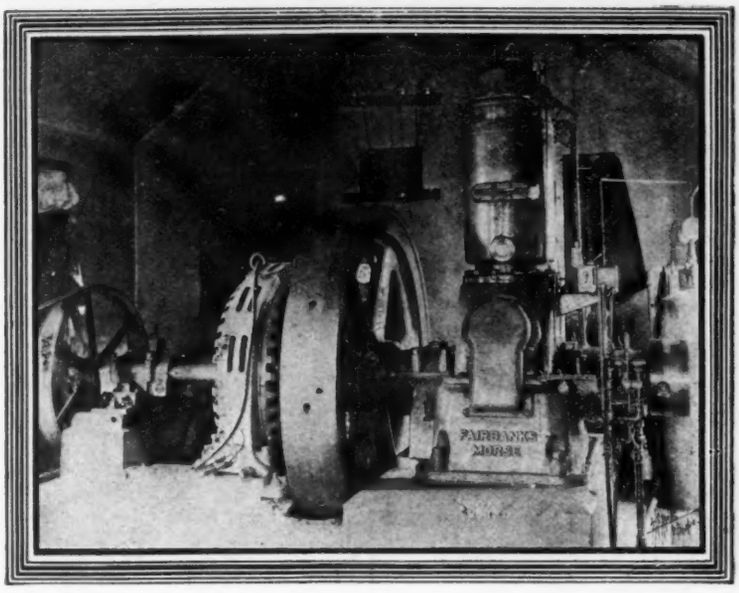
CROCKER-WHEELER COMPANY

AMPERE, NEW JERSEY

New York, Boston, Syracuse, Chicago, Cleveland, Birmingham, Pittsburgh, Newark, New Haven, Philadelphia, Baltimore, San Francisco

WHAT AND WHERE TO BUY

Pumps, Electric Garage
Fairbanks, Morse & Co.
Pumps, House Service
Midwest Engine Co.
Pumps, Motor Driven
Fairbanks, Morse & Co
Pumps, Oil
Fairbanks, Morse & Co
Richardson-Phenix Co.
Pumps, Steam Driven
Allis-Chalmers Mfg. Co.
Fairbanks, Morse & Co.
Midwest Engine Co.
Terry Steam Turbine Co
Pumps, Turbine Driven
Terry Steam Turbine Co.
Pumps, Vacuum
Fairbanks, Morse & Co.
Terry Steam Turbine Co.
Pumps, Water Works
Fairbanks, Morse & Co
Pyrometers
Bristol Co., The.
Leeds & Northrup Co.
Rail Bonds
American Steel & Wire Co
Condit Electrical Mfg. Co.
Ohio Brass Co.
Ranges, Elec.
General Electric Co.
Westinghouse Elec. & Mfg. Co.
Receptacles. (See Sockets and Receptacles)
Receptacles, Sign
Benjamin Electric Mfg. Co
Federal Elec. Co.
Rectifiers.
Electric Products Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.
Reflectors
Adams Bagnall Elec. Co.
Benjamin Electric Mfg. Co.
Ivanhoe-Regent Works
Refrigerating Machines
Kelvinator Corp.
Repairing
See Searchlight Section.
Cleveland Armature Wks.
Commonwealth Edison Co.
Denton Engr. & Constr. Co.
Elec. Motor & Repair Co.
Nelson, I. R.
Resistance Units
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.
Ellcon Co.
Gen. Elec. Co.
Industrial Controller Co.
Ward Leonard Elec. Co.
Westinghouse Elec. & Mfg. Co.
Rheostats
Biddle, James G.
Campbell Electric Co.
Cutler-Hammer Mfg Co.
Electric Controller & Mfg. Co.
Electric Products Co.
General Electric Co.
Industrial Controller Co.
Monitor Controller Co.
Sundh Electric Co.
Ward Leonard Elec. Co.
Westinghouse Elec. & Mfg. Co.
Rivets
Atlas Bolt and Screw Co.
Roofing
Barrett Co., The
Rosettes
Arrow Electric Co.
National Metal Molding Co.
Pass & Seymour, Inc.
Screens, Intake Water
Link-Belt Co.
Screw Machine Products
Atlas Bolt and Screw Co.
Blake & Johnson
Thoner & Martens
Searchlights
General Electric Co.
Second-hand Apparatus
See Searchlight Section
Adams, Geo. Francis.
American Assn. of Engrs.
Archer & Baldwin.
Bissell Co., F.
Breu, William P.
Brown-Hunkele Corpn.
Carrell & Co., W. A.
Chuse Engine Co., H. A. & G. X.
Cleveland Armature Works
Commonwealth Edison Co.
Consolidated Gas, Elec. Light & Power Co.
Davis, J. F.
Davis Machine & Motor Co.
Denton Engr. & Constr. Co.
Donahoo Co., J. F.
Dotterweich Co., A. J.
Duquesne Elec. & Mfg. Co.
Electric Motor & Repair Co.
Elliott Elec. Co.
Garrity, Ralph A.
Geare & Co.
General Equipment Co.
Goodrich Co., B. F.
Graham, Jas. A.
Greenfield Elec. Mfg. Co
Gregory Electric Co.
Harris Bros. Co.
Herfurth Eng. & Mchy. Co.
Holcomb, D. S.
Independent Elec. Mach'y Co.
Kirchner-Purcell Co.
Klein & Co., Nathan.
MacGovern & Co., Inc.
Miller-Owen Electric Co.
Monarch Elec. Motor Co.
Myerson, Joseph
Natl. Power Machy. Co.
Nelson, I. R.
Olean Elec. Light & Power Co.
Phillips, Leo A.
Power Equip. Co., Engrs.
Power Machy. Exchange.
Randle Machinery Co.
Reliable Electric Motor Co.
Rochester Elec. Supply Co.
Ross Power Equipment Co.
Sachsenmaier & Co., Geo.
Salzberg Co., Inc., H.
Scheinert Co., R.
Schwartz & Land.
Standard Elec. & Elevator Co.
Stewart & Co., Paul
Tiffany, Hall & Co., Inc.
Toomey, Inc., Frank.
Venino Bros. & Co.
Vindex Elec. & Mfg. Co
Werby & Co., A.
Wicks Machinery Co.
Wilson Machy. Co., H. R.
Zelnicker Supply Co., Walter A.
Separators, Magnetic
Cutler-Hammer Mfg. Co.
Separators, Oil
Benjamin Electric Mfg. Co
Griscom-Russell Co.
Shade Holders
Adams-Bagnall Elec. Co
Patton McGuyer Co.
Hubbell, Inc., Harvey.
Sheet Metal
Am. Sheet & Tin Plate Co.
Bliss Co., E. W.
Sheets, Electrical
Am. Sheet & Tin Plate Co.
Signals, Industrial
Benjamin Electric Mfg. Co
Signs
Federal Elec. Co.
Sign Letters
Federal Elec. Co.
Silent Chain Drives
Link-Belt Co.
Slate, Common Structural
Structural Slate Co.
Sockets and Receptacles
Arrow Electric Co.
Benjamin Electric Mfg. Co.
Bryant Electric Co.
Cutler-Hammer Mfg. Co.
Federal Elec. Co.
General Electric Co.
Hubbell, Inc., Harvey
National Metal Molding Co.
Pass & Seymour, Inc.
Philadelphia Elec. & Mfg. Co.
Socket, Turndown
Pass & Seymour, Inc.
Soldering Flux
Blake Signal & Mfg. Co.
Soldering Irons
Cutler-Hammer Mfg. Co.
Solenoids
Electric Controller & Mfg. Co.
General Electric Co.
Industrial Controller Co.
Ward Leonard Elec. Co.
Soot Blowers
Bayer Steam Soot Blower Co.
Diamond Power Specialty Co.
Soot Cleaners, Boiler
Bayer Steam Soot Blower Co.
Diamond Power Specialty Co.
Special Machinery
Hartford Time Switch Co.
Blake & Johnson
Springs
American Steel & Wire Co.
Cary Spring Works.
Barnes Co., W.
Sprockets, Silent Chain
Link-Belt Co.
Morse Chain Co.
Stacks, Steel, Smoke
American Bridge Co.
Condit Elec. Mfg. Co.
Stage Lighting Apparatus
Campbell Electric Co.
Condit Electrical Mfg. Co.
Staples
American Steel & Wire Co.
Blake Signal & Mfg. Co.
Starters, Motor
Condit Elec. Mfg. Co.
Cutler-Hammer Mfg. Co.
Electric Controller & Mfg. Co.
General Electric Co.
Sundh Elec. Co.
Ward Leonard Elec. Co.
Westinghouse Elec. & Mfg. Co.
Stokers
American Engineering Co.
Combustion Engineering Corp.
Green Eng'g Co.
Riley Stoker Co., Sanford, Ltd.
Underfeed Stoker Co.
Westinghouse Elec. & Mfg. Co.
Stokers, Pulverized Coal
Pulverized Fuel Equipment Corp.
Stoves, Elec. (See Ranges, Elec.)
Structural Steel
Blaw-Knox Co.
Milliken Bros. Mfg. Co.
Sub-Stations, Outdoor
Delta Star Elec. Co.
General Elec. Co.
Westinghouse Elec. & Mfg. Co.
Superheaters, Steam
Locomotive Superheater Co.
Supplies (Electric Railway)
Benjamin Electric Mfg. Co.
Johns Manville & Co., H. N.
General Electric Co.
Ohio Brass Co.
Western Elec. Co.
Westinghouse Elec. & Mfg. Co.
Supplies, Electrical.
Austin Co., The
Benjamin Electric Mfg. Co.
Electrical Supply Jobbers Assn.
General Electric Co.
Manhattan Elecl. Supply Co.
Pass & Seymour
Philadelphia Elec. & Mfg. Co
Western Elec. Co.
Switchboard Supplies
Condit Elec. Mfg. Co.
General Electric Co.
Lewis & Roth Corp.
Roller-Smith Co.
Westinghouse Elec. & Mfg. Co.
Switchboards
Allis-Chalmers Mfg. Co.
Anderson Mfg. Co., A. & J. M.
Condit Elec. Mfg. Co.
Electric Products Co.
Electrical Engineering Co.
General Electric Co.
Roller-Smith Co.
Triumph Electric Co.
Trumbull Elec. Mfg. Co.
Wagner Elec. Mfg. Co.
Western Elec. Co.
Westinghouse Elec. & Mfg. Co.
Switches, Automatic Time
Anderson Mfg. Co., A. & J. M.
General Elec. Co.
Hartford Time Switch Co.
Matthews & Bro., Inc., W. N.
Westinghouse Elec. & Mfg. Co.
Switches, Disconnecting
Anderson Mfg. Co., A. & J. M.
Delta Star Elec. Co.
Electrical Engineers Equipment Co.
General Elec. Co.
Lewis & Roth Corp.
Matthews & Bro., Inc., W. N.
Schweitzer & Conrad, Inc.
Trumbull Electric Mfg. Co.
Westinghouse Elec. & Mfg. Co.
Switches, Enclosed
Electric Service Corp.
General Elec. Co.
Trumbull Elec. Mfg. Co.
Westinghouse Elec. & Mfg. Co.
Switches, Float
Cutler-Hammer Mfg. Co.
General Elec. Co.
International Radio Tel. Co.
Kuhlman Elec. Co.
Sundh Electric Co.
Westinghouse Electric & Mfg. Co.
Switches, Fuse
General Electric Co.
Matthews & Bro., Inc., W. N.
Metropolitan Eng'g Co.
Switches, Knife
Condit Elec. Mfg. Co.
Electric Controller & Mfg. Co.
General Electric Co.
Trumbull Elec. Mfg. Co.
Westinghouse Elec. & Mfg. Co.
Switches, Oil.
Condit Elec. Mfg. Co.
General Electric Co.
Westinghouse Elec. & Mfg. Co.
Switches, Pole Top
Condit Elec. Mfg. Co.
Delta-Star Elec. Co.
Electrical Engineers Equipment Co.
General Electric Co.
Lewis & Roth Corp.
Switches, Remote Control
Anderson Mfg. Co., A. & J. M.
Cutler-Hammer Mfg. Co.
General Electric Co.
Sundh. Elec. Co.
Westinghouse Elec. & Mfg. Co.
Switches, Safety.
Electric Service Corp.
General Elec. Co.
Trumbull Elec. Mfg. Co.
Westinghouse Elec. & Mfg. Co.
Switches, Series
General Elec. Co.
Switches, Snap and Push Button
Arrow Electric Co.
Bryant Electric Co.
Cutler-Hammer Mfg. Co
General Electric Co.
Pass & Seymour, Inc.
Western Electric Co.
Switches, Time
Campbell Electric Co.
General Elec. Co.
Matthews & Bro., Inc., W. N.
Paragon Electric Co.
Synchroscopes
Westinghouse Elec. & Mfg. Co.
Weston Elec. Instrument Co.
Tachometers
Biddle, James G.
Bristol Co., The.
Central Scientific Co.
Foxboro Co., The.
Johns-Manville Co., H. W.
Roller-Smith Co.
Taps and Dies
Carpenter Tap & Die Co., J. M
Greenfield Tap & Die Co.
Tar, Coal
Barrett Co., The
Telephone Service
American Tel. & Tel. Co.
Telephones
Holtzer-Cabot Electric Co
Western Elec. Co.
Testing Apparatus
American Transformer Co
Biddle, James G.
Leeds & Northrup Co.
Rawson Elecl. Instrument Co
Roller-Smith Co.
States Company, The
Thompson, Levering Co.
Westinghouse Elec. & Mfg. Co
Testing Laboratories
Elecl. Testing Laboratories.
Illinois Testing Laboratories
Theatre Dimmers
Cutler-Hammer Mfg. Co.
General Electric Co.
Industrial Controller Co.
Ward Leonard Elec. Co
Thermometers
Bristol Co., The.
Foxboro Co., The.
Taylor Instrument Co
Thrust Bearings
Kingsbury, Albert
Tin Wires
Page Steel & Wire Co.
Tools, Construction
Klein & Sons, Mathias
Oshkosh Mfg. Co.
Tools, Drills, Punches, etc.
Goodell-Pratt Co.
Tools, Linemen's
Bush Electric Co.
Klein & Sons, Mathias
Western Elec. Co.
Tools, Portable Elec.
Chicago Pneumatic Tool Co.
Towers, Radio
American Bridge Co.
Blaw-Knox Co.
Milliken Bros. Mfg. Co.
Towers, Transmission
American Bridge Co.
Archbold-Brady Co.
Bates Exp. Steel Truss Co.
Blaw-Knox Co.
Coombs & Co., R. D.
Milliken Bros. Mfg. Co.
Track, Industrial Railway
Easton Car & Construction Co
Traps, Steam
Elliott Company, The
Transformers.
Adams Bagnall Elec. Co.
Allis-Chalmers Mfg. Co.
American Transformer Co.
Campbell Electric Co.
Crocker-Wheeler Co.
Duncan Elec. Mfg. Co.
Metropolitan Eng'g Co.
Moloney Elec. Co.
Pittsburgh Transformer Co.
Thordarson Electric Co.
Triumph Electric Co.
Wagner Elec. Mfg. Co.
Westinghouse Elec. & Mfg. Co
Transformers, Bell Ringing
Pittsburgh Transformer Co.
Westinghouse Elec. & Mfg. Co
Transmission, Silent Chain
Link-Belt Co.
Morse Chain Co.
Treads, Ladder and Stair, Non-Slipping
Irving Iron Works Co.
Trucks, Gasoline
White Co., The
Turbines, Hydraulic
Pelton Water Wheel Co.
Turbines, Steam
Allis-Chalmers Mfg. Co.
General Electric Co.
Midwest Engine Co.
Ridgway Dynamo & Eng. Co.
Sturtevant Co., B. F.
Terry Steam Turbine Co.
Westinghouse Elec. & Mfg. Co.
Turbo-generators
Terry Steam Turbine Co.
Westinghouse Elec. & Mfg. Co.
Turntable, Industrial Railway
Easton Car & Construction Co.
Vacuum Cleaners, Electric
Electric Vacuum Cleaner Co., Inc
Federal Elec. Co.
United Elect. Co.
Western Electric Co.
Valves
Elliott Company, The
Nelson Valve Co.
Richardson-Phenix Co.
Valves, Blow-off
Ohio Brass Co.
Valves, Discs
Ostrander & Co., W. R.
Valves, Superheated Steam
International Nickel Co.
Nelson Valve Co.
Richardson-Phenix Co.
Valve Trim
International Nickel Co.



You'll Get Dependable Power from Low-priced Fuel Oils

You buy an engine for power. You have a right to expect low upkeep cost. You'd like to have ease of operation, simple construction and fool-proof design. You should get the facts about the Fairbanks-Morse "Y" Oil Engine. How economically it uses low priced fuel oils. How simple in construction. How strong it is. And then investigate the engines in service. That's the best test. Learn of the successful performance of large numbers of "Y" engines —many of them working day and night continuously—at the very kind of work you want an engine to do—then you'll buy a "Y"—the engine of true economy. Guaranteed by Fairbanks-Morse Quality.

Fairbanks, Morse & Co.
MANUFACTURERS CHICAGO

Engines - Pumps - Motors - Hoists - Air Compressors - Fairbanks Scales - Sheffield Motor Cars - Standpipes - Coaling Stations - Etc.

WHAT AND WHERE TO BUY

Vibrators
Shelton Elec. Co.
Washers
Massachusetts Machine Shop, Inc.
Washing Machines, Electric
Automatic Electric Washer Co.
Fairbanks, Morse & Co.
Federal Elec. Co.
Hoover Suction Sweeper Co.
Nineteen Hundred Washer Co.
Western Elec. Co.
Waterproofing
Barrett Co., The
Johns-Mannville Co., H. W.
Mitchell-Rand Mfg. Co.
Water Purifying Apparatus
Griscom-Russell Co.
Permutit Company.
Water Softening Apparatus
Permutit Company.
Scaife & Sons Co., Wm. B.
Water Wheels and Turbines
Allis-Chalmers Mfg. Co.
Leffel & Sons Co., James
Pelton Water Wheel Co.
Smith Co., S. Morgan
Trump Mfg. Co.
Water Wheel Governors
Lombard Governor Co.
Pelton Water Wheel Co.
Wattmeters, Watt-Hour Meters (See Instruments, Electrical.)
Weatherproof Wire
Roebling's Sons Co., J. A.
Standard Underground Cable Co.
Welders, Electric Arc
Westinghouse Elec. & Mfg. Co.
Winding Machinery
Coto-Coil Co.
Wire, Copper Clad
Standard Underground Cable Co.
Wire, Rubber Covered
A. A. Wire Co., Inc.
Hazard Mfg. Co.
Roebling's Sons Co., John A.
Atlantic Ins. Wire & Cable Co.
Belden Mfg. Co.
Bridgeport Brass Co.
British Aluminum Co., Ltd.
Woodward Governor Co.
Hazard Mfg. Co.
Independent Lamp & Wire Co.
Rome Wire Co.
Wires, Resistance
Driver-Harris Wire Co.
Electrical Alloy Co.
Wires and Cables
A. A. Wire Co.
Acme Wire Co.
Aluminum Co. of America.
Amer. Brass Co.
Amer. Electrical Works.
Amer. Steel & Wire Co.
Anaconda Copper Mining Co.
Ansonia Elec. Co.
D & W Fuse Co.
Driver-Harris Wire Co.
General Electric Co.
Goodrich Rubber Co., B. F.
Habirshaw Elec. Cable Co.
Indiana Rub. & Ins. Wire Co.
Kerite Ins. Wire & Cable Co.
Lowell Ins. Wire Co.
Massachusetts Elec. Mfg. Co.
National Conduit & Cable Co.
New England Butt Co.
New York Insulated Wire Co.
Okonite Co., The
Phillips Wire Co.
Roebling's Sons Co., J. A.
Rome Wire Co.
Safety Ins. Wire & Cable Co.
Simplex Wire & Cable Co.
Standard Underground Cable Co
Western Elec. Co.
Wire and Cables Auto
Rome Wire Co.
Wire, Resistance
International Nickel Co.
Wiring Devices
Arrow Electric Co.
Benjamin Electric Mfg. Co.
Peru Electric Co.
Wood, Pipe
Continental Pipe Mfg. Co.
X-Ray Apparatus
Anderson Mfg. Co., A. & J. M.
Campbell Electric Co.
General Elec. Co.

Employment "Opportunities"

JOBS and MEN—For Plant and Office: Technical, Executive, Operative and Selling: *See "SEARCHLIGHT"*

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TO BUY, SELL, RENT and EXCHANGE—Used and Surplus New Equipment and Material—*See "SEARCHLIGHT"*

Business "Opportunities"

OFFERED and WANTED—Contracts, Capital, Plants, Properties, Franchises, Auctions—*See "SEARCHLIGHT"*

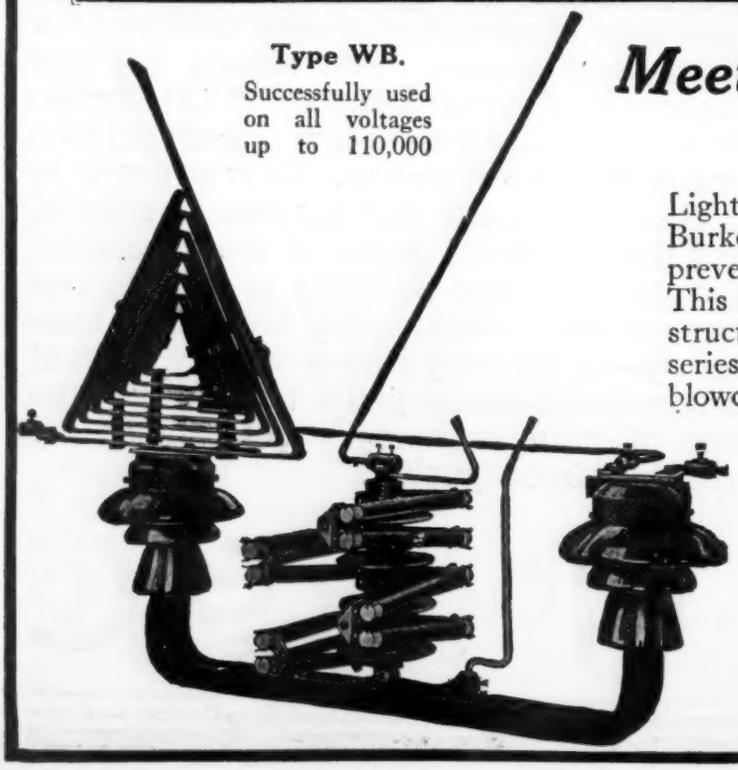
For "Opportunities" of every kind: "Think SEARCHLIGHT First!"

0103

The BURKE ARRESTER

THE HORN GAP ARRESTER WITH THE TRIANGULAR CHOKE COIL

Type WB.
Successfully used on all voltages up to 110,000



Meets Most Exacting Needs

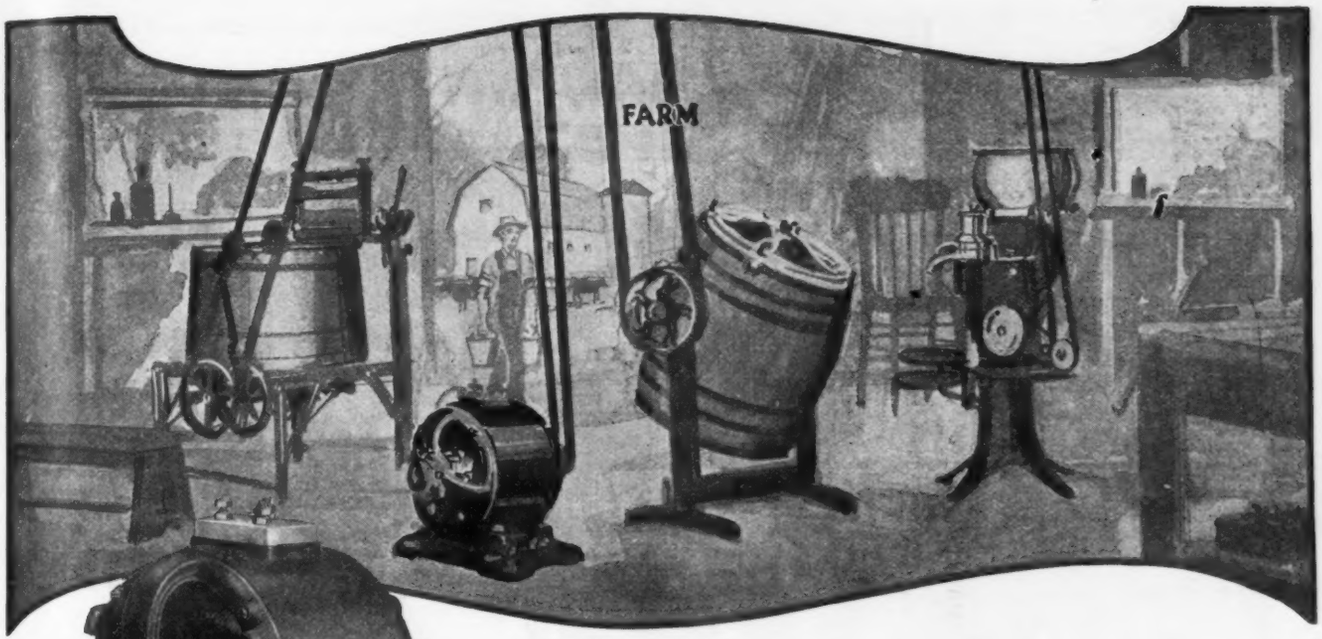
Lightning seeks a path to ground. The Burke Arrester provides a direct path and prevents surges p assing the discharge gap. This is due to the triangular choke coil construction with its sharp turns, its sensitive series horn gap, its quick- acting magnetic blowout and its straight line discharge path

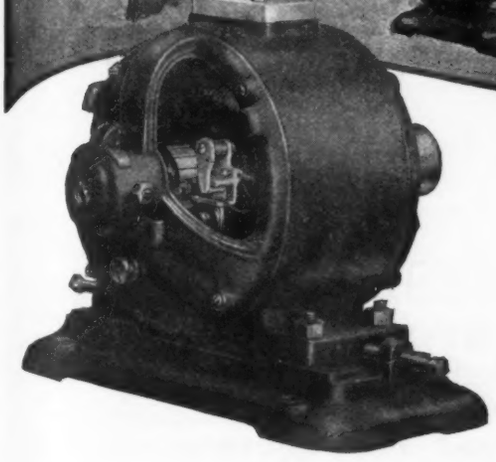
Write for Bulletin.

Type WB, as well as WBR (for larger transmission systems) are pictured and described in an interesting bulletin, sent on request.

Railway and Industrial Engineering Company

Sales Office **Pittsburgh**
Plant **Greensburg, Pa.**





The Farmer Needs a Good Motor Too

The advent of electricity on the farm creates a new motor use. And the Farmer must have a dependable motor —one whose performance strengthens his growing faith in electric Power for his use.

Peerless motors are the good dependable motors—the result of years of experience in motor building—built to a standard which must uphold the name Peerless. Built for 32 volts.

OTHER PEERLESS MOTORS

D. C.

Multipolar Motors and Generators
Sizes up to 35 H.P.
Bipolar Motors and Generators
Sizes up to 2 H.P.
Low Voltage Motors and Generators

A. C.

Poly-Phase Motors.
Split-Phase Motors.
Single-Phase Repulsion Induction Motors.
Synchronous Motors.
Motor Generator Sets.
D.C. and A.C. Fan Motors.

PEERLESS ELECTRIC CO.

Warren, Ohio

Representatives

New York—C. O. Hall—147 W. 35th St.

Philadelphia—Walter L. Veit—The Bourse Bldg.

Chicago—The Electrical Machinery Sales Co.—327 So. La Salle St.

Toledo—The F. Bissell Co.

Minneapolis—The Electrical Machinery Sales Co.—Plymouth Bldg.

New Orleans—The Electric Appliance Co.

Los Angeles—The Garland Affolter Co.

San Francisco—The Garland Affolter Co.

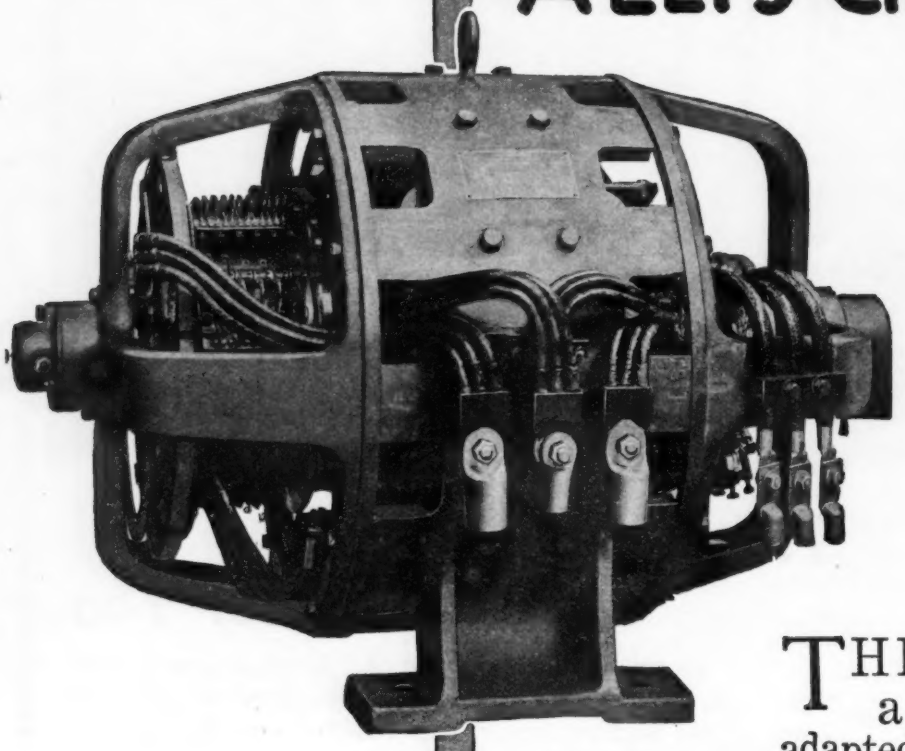
Seattle—The Garland Affolter Co.

St. Louis—L. M. Sperry—917 Pine St.

Buffalo—J. E. Hoffman—280 Carolina St.

Peerless MOTORS

ALLIS-CHALMERS



Bracket Bearing Type Rotary Converters

THESE machines are especially adapted to small industrial plants, mining service and similar installations where a rugged, compact machine is required to deliver direct current when fed from an alternating current supply system.

Ratings of 100 K. W., 150 K. W. and 200 K. W. are built in this type, all being for 60 cycles, six phase and 250 or 275 volts.

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Milwaukee Wis.

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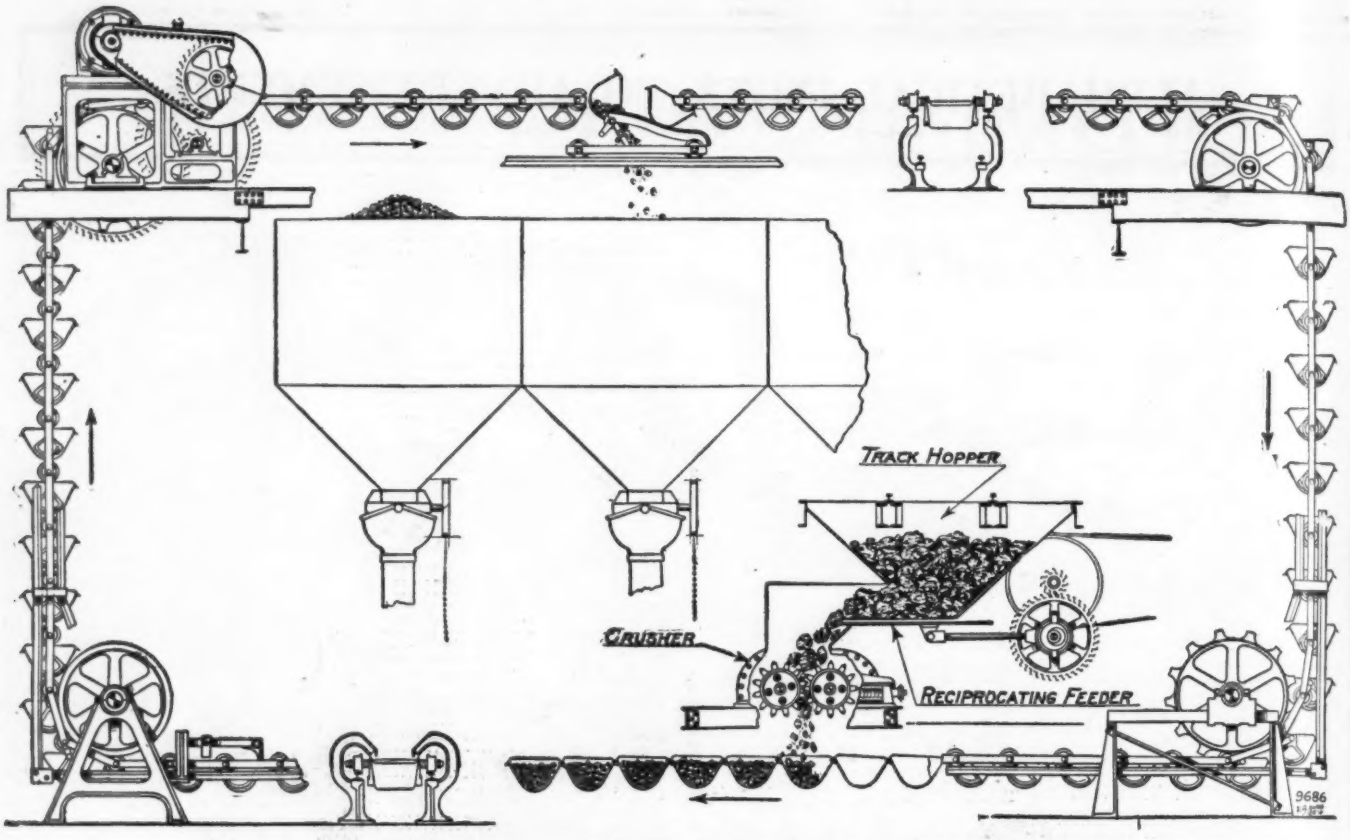

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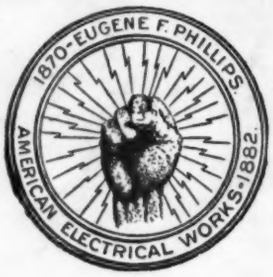

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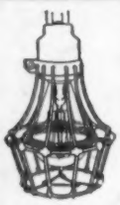

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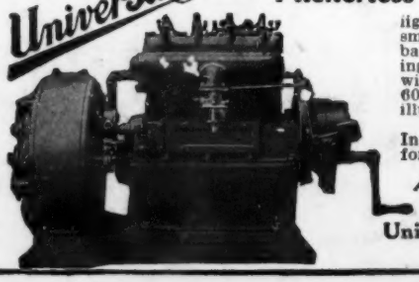

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